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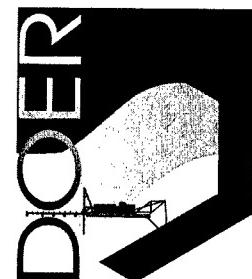
Dredging Operations and Environmental Research Program

Innovations in Dredging Technology: Equipment, Operations, and Management

by *T. Neil McLellan, Robert J. Hopman*
Hartman Consulting Corporation

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Prepared for Headquarters, U.S. Army Corps of Engineers

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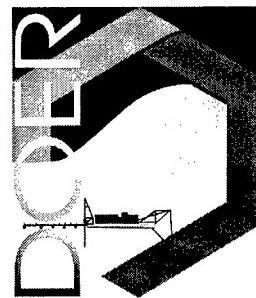
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Dredging: Innovative Technology

Innovations in Dredging Technology: Equipment, Operations, and Management (ERDC TR-DOER-5)

ISSUE: Historically, there has been no programmatic or systematic approach to the demonstration, evaluation, and reporting of new or innovative applications of dredging technology in the U.S. Army Corps of Engineers dredging program. Attempts to exploit innovations developed within and outside the United States have also been random and less than ideal. To take advantage of advances in dredging technology, a contract was awarded to survey and catalogue innovative equipment, operations, and management techniques showing high potential for use in Corps dredging projects.

RESEARCH: The objective of the study was to identify foreign and domestic commercial technology that could help in reducing the overall cost of performing and managing dredging products in the Corps. These technologies were to be identified as having a high potential for increasing efficiency or productivity of the dredging operations in order to be selected for evaluation using the following criteria: need in Corps navigation dredging program, positive benefits versus costs, high probability of implementation, and availability of co-sponsor.

SUMMARY: Initially, a literature review was used to identify the vast array of technologies and categories of equipment and procedures pertaining to dredging operations with emphasis on

European applications. Several hundred documents and technologies were researched pertaining to innovative dredging technologies and procedures. A series of site visits were made to several institutions, dredge contractors, port authorities, and project sites in Belgium, the United Kingdom, The Netherlands, and Germany. Ninety-one technology fact sheets were prepared and each fact sheet contains the following types of information about that technology: technology name, category, description, company/organization, projects completed, information sources, and literature references.

The report provides detailed descriptions of 11 of the 91 technologies identified as having promise. By investigating and documenting these solutions and reviewing them relative to the Corps dredging program, there is potential to identify and implement those procedures showing high promise to reduce the cost of conducting dredging operations performed or managed by the Corps.

AVAILABILITY OF REPORT: The report is available in .pdf format on the World Wide Web at <http://www.wes.army.mil/el/dots/doer/> and through Interlibrary Loan Service from the U.S. Army Engineer Research and Development Center (ERDC), Waterways Experiment Station (WES) Library, telephone (601) 634-2355.

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Preface

The work described in this report was authorized by Headquarters, U.S. Army Corps of Engineers (HQUSACE), and completed as part of the Innovative Dredging Technologies Focus Area of the Dredging Operations and Environmental Research (DOER) Program. The work was performed under Work Unit 33092, "Demonstration of Innovative Dredging Technologies," for which Messrs. E. Clark McNair, Coastal and Hydraulics Laboratory (CHL), and Norman R. Francinques, Jr., Environmental Laboratory (EL), were co-Technical Managers. Mr. Barry Holliday, HQUSACE, was the Chief DOER Technical Monitor.

This report was prepared under contract by Messrs T. Neil McLellan, P.E., and Robert J. Hopman, P.E., of Hartman Consulting Corporation, a subsidiary of Foster Wheeler Environmental Corporation, Bellevue, Washington. This work was funded by task order contract from the U.S. Army Engineer District, Sacramento, on behalf of the Waterways Experiment Station.

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The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the U.S. Army Corps of Engineers.

The study was conducted under the following ERDC supervision:

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CHL - Mr. E. Clark McNair, Dredging Operations and Environmental Research Program; Dr. James R. Houston, Director, CHL.

At the time of preparation of this report, Dr. Ed Link was Acting Director of ERDC, and COL Robin R. Cababa, EN, was Director.

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1 Introduction

The Dredging Operations and Research Program (DOER) at the Waterways Experiment Station (WES) in Vicksburg, Mississippi, has identified six applied research focus areas to develop technology, methodology, and techniques to ensure that the operational and environmental issues of the U.S. Army Corps of Engineers (Corps) dredging program are met adequately and efficiently. One of the six focus areas is "Innovative Technology."

In the past, there has not been a programmatic or systematic approach to ensure adequate demonstration, evaluation, and reporting of new innovative dredging technology applications. The objective of this study effort is to identify existing technologies, procedures, and management techniques developed domestically and internationally that could help reduce the overall cost of conducting the Corps' dredging operations. The effort documents state-of-the-art innovations in dredging technology and related dredging and dredged material process technologies. Identification focuses on existing technologies that do not require research and development funding for implementation.

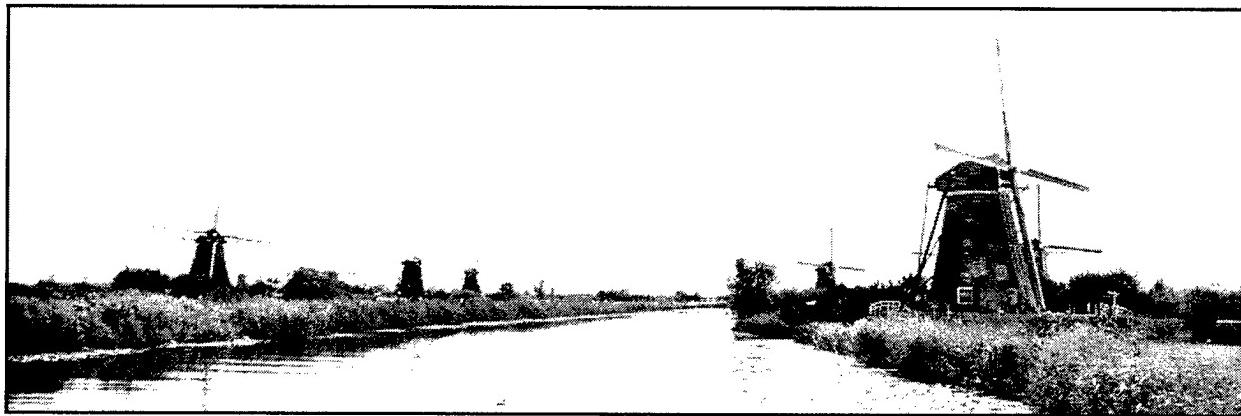


Figure 1. Windmills at Kinderdijk, Holland (Hartman Consulting Corporation 1999, used by permission)

2 Discussion

The innovative dredging technology task consists of identifying and cataloging innovative dredging operations, processes, or equipment developed by dredging and dredging-related industries worldwide. “Innovative dredging technology” is defined as improved dredging equipment, methods, or operations that do not require research and development. These are “off-the-shelf” products. Candidate technologies with the greatest potential will be demonstrated in the field with DOER providing scientific and engineering expertise for monitoring and evaluation of the demonstration. Candidate technologies will be reviewed based on various criteria. These criteria will include need, positive cost/benefit relationship, high probability of implementation, and availability of a demonstration cosponsor. Candidate technologies must demonstrate a high potential for increasing the efficiency or productivity of dredging operations to be considered for demonstration.

DOER will provide the engineering and scientific expertise to evaluate the demonstration and perform technology transfer. The sponsoring partner, usually a District or Division Office, may provide in-kind services such as equipment rental, mobilization and demobilization of equipment, and other supporting activities. This will allow limited focus area funds to be used strictly for technology evaluation.

This report includes information gathered from various sources in several countries. It is intended to serve as a comprehensive and convenient reference on the various innovative dredging technologies currently available around the world.

3 Procedure

The first step in any effort to identify existing dredging techniques, procedures, and management techniques developed by domestic and international interests is the assembly and evaluation of all prior information about the effort. Information gained from a literature search is used to develop a basic profile of innovative technology. Sources of information include brochures, Web pages, periodicals, publications, and technical papers such as the World Organization of Dredging Association (WODA) proceedings. Several hundred documents were reviewed in the innovative dredging technology literature search.

A database was created to record information pertaining to innovative technologies, procedures, or methods obtained throughout the research process. Microsoft Access 97 was selected as a commercially available, state-of-the-art relational database program on which to build the Innovative Dredge Technology Database (database). The database would be used to evaluate investigated technologies, methods, and procedures for applicability to Corps dredging programs and contracts, and to provide a repository for the data that would allow the information to be modified or expanded. The database was structured to individually record detailed information about a technology. Each candidate technology is assigned an individual technology number. Technology details are input in four data input areas (forms):

- a.* Innovative Dredge Technology Data.
- b.* Company/Organization Data.
- c.* Projects Completed with Innovative Technology.
- d.* Information Sources.

Each form provides subareas to input details of the technology. The database can be continuously expanded and individual records modified as new technologies are investigated and more information is found on technologies already recorded. At any time the database can be queried to provide a search on any major subject (i.e., technology category, company, projects completed, cost). Individual database records can be viewed and printed in either the query mode or in report format.

On completion of the literature search, the various organizations that managed or owned promising innovative technologies with potential

application in the Corps dredging program were contacted. Contacts were made in several ways. Questionnaires were provided to a number of organizations including equipment vendors, universities, government agencies, port Districts, research facilities, and the dredging industry. The questionnaire's primary purpose was to define and direct the innovative technology discovery. Other contacts were made by telephone or personal visit. Every effort was made to interact with representatives of organizations that were thought to have an innovative offering, and functional evidence of a proven technology was looked for. In addition, intuition and personal judgment based on experience were used along with direction from the Corps and other expertise. Data were continually updated throughout this information-gathering phase.

4 Detailed Evaluations

Of the many documents and technologies pertaining to innovative technology and procedure, 11 were identified by the contractor for detailed evaluations as related to the present and long-term needs of the Corps. This section describes the 11 technologies listed below. Additional technologies are listed in Chapter 5.

- Underwater Archimedean screw vehicle.
- The PUNAISE dredging system.
- Hopper dredge recirculation system.
- DOP submersible dredge pumps.
- Pivoting gearbox.
- High-efficiency dredge pumps.
- The SedErode measurement system.
- Nearshore shelves.
- Sand separation techniques.
- River vanes.
- Detailed shoaling analyses.

Underwater Archimedean Screw Vehicle

Background

Harbor Branch Oceanographic Institution, Inc., has constructed and successfully operated an underwater bottom-crawling dredging device called the underwater Archimedean screw vehicle (UASV) (Figure 2). The dredge is designed to surgically remove thin layers of fine-grained materials with an accuracy of 2 to 4 in.



Figure 2. Archimedean screw vehicle (Harbor Branch Oceanographic Institution, Inc. 1999; used by permission)

Technology

The UASV is a bottom-crawling machine approximately 15 ft long, 8 ft wide, and 6 ft tall. It can move forward, backward, and sideways using Archimedean screw propulsion technology. The vehicle also incorporates remotely operated vehicle (ROV) principles to assist in guidance, navigation, and control. It uses the Digital Global Positioning System (DGPS) for location and has imaging systems that show where the dredge is at all times. The dredging path is preprogrammed. It has two dredging hoods, located at each end of the dredge. The dredge fluidizes the bottom material with a

low-pressure supply pump (80 gpm). This allows selective removal of fine-grained sediments into an enclosed hood for slurry pipeline transport to shore. The dredging hoods are designed to allow sand material (greater than 120 microns) to fall back to the bottom and only fine-grained sediment is removed.

Current usage

The UASV has successfully worked at an Orange County Water Management District (California) recharge reservoir. The system covered approximately 2 acres of bottom in an 8-hr work period, removing approximately 100 yd³/hr (in situ).

Potential application

The underwater Archimedean screw vehicle has potential application in the following circumstances:

- a. *Contaminated sediment prospects where the contamination is contained within the top layer of the project.* The dredge can be used to surgically remove the contaminated sediment. Conventional dredging could then be applied to the remaining sediment.
- b. *Canals and lakes choked with fine-grained sediments (muck).* The USAV can work in confined areas, because it is relatively small and does not need room to turn around. It dredges from either end of the vessel and moves sideways for dredge cut setup. It removes only the fine-grained sediment, leaving sand on the bottom, which is often desirable in recreation areas.
- c. *Under-pier dredging.* The UASV is small, can work in confined areas, and is remote-controlled.

Cost

The 8-ft dredge turnkey package, which includes the dredge, trailer, and pipeline, costs between \$750,000 and \$1,000,000.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

The PUNAISE Dredging System

Background

Pinpoint Dredging Company of The Netherlands has constructed and successfully tested and operated the PUNAISE (Dutch for “thumbtack”). The PUNAISE is operated by the Pinpoint Dredging Company, a partnership consisting of J.G. Melis B.V., Ballast Nedam Dredging B.V., and Boskalis International B.V. The PUNAISE is a remotely operated, watertight, submerged pumping system (Figure 3) that can remove bottom sediments without impact to navigation and without being affected by storms.

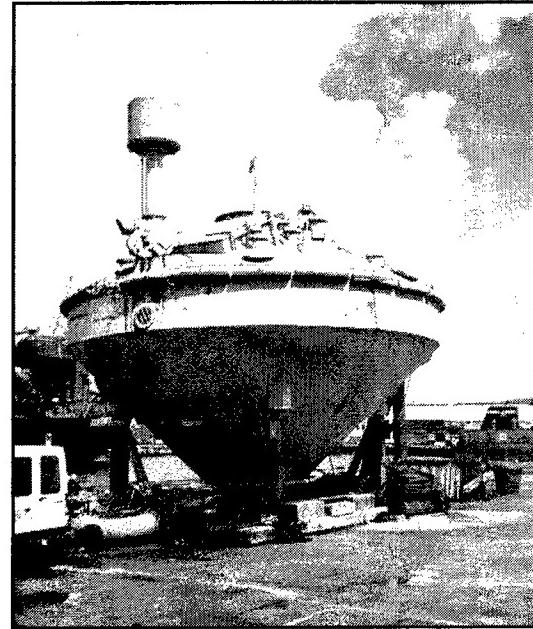


Figure 3. PUNAISE at dock (Pinpoint Dredging Company 1999; used by permission)

Technology

The PUNAISE is composed of a watertight housing containing the dredge pump, motor, and ballast tanks (Figures 4 and 5). It is connected to the shore station via an umbilical that consists of control connections, power supply, and a slurry discharge line. While in operation, the PUNAISE resides on the bottom of the seafloor and pumps sediment without impact to surface vessels. Because it is located on the seafloor, it is tolerant of adverse surface wave action. This allows it to operate in all types of weather and sea state conditions.

Once positioned at the appropriate location for sinking to the bottom, the ballast tanks are filled and the PUNAISE settles to the bottom. Fluidizers are then activated, which allow the vertical support to settle into the sand bottom so the dredging process can begin. As material is removed, a crater or pit is formed with the PUNAISE located at the lowest point. The submerged machine excavates by means of hydraulic erosion. This creates unstable slopes down where sediment flows to the suction entrance.

There are three PUNAISE models, PN 200, PN 250, and PN 400. The PN 200 and PN 250 and ancillary equipment can be transported within containers, while the PN 400 must be transported through conventional shipping. Cable systems and pumping operations currently limit the ideal pump-

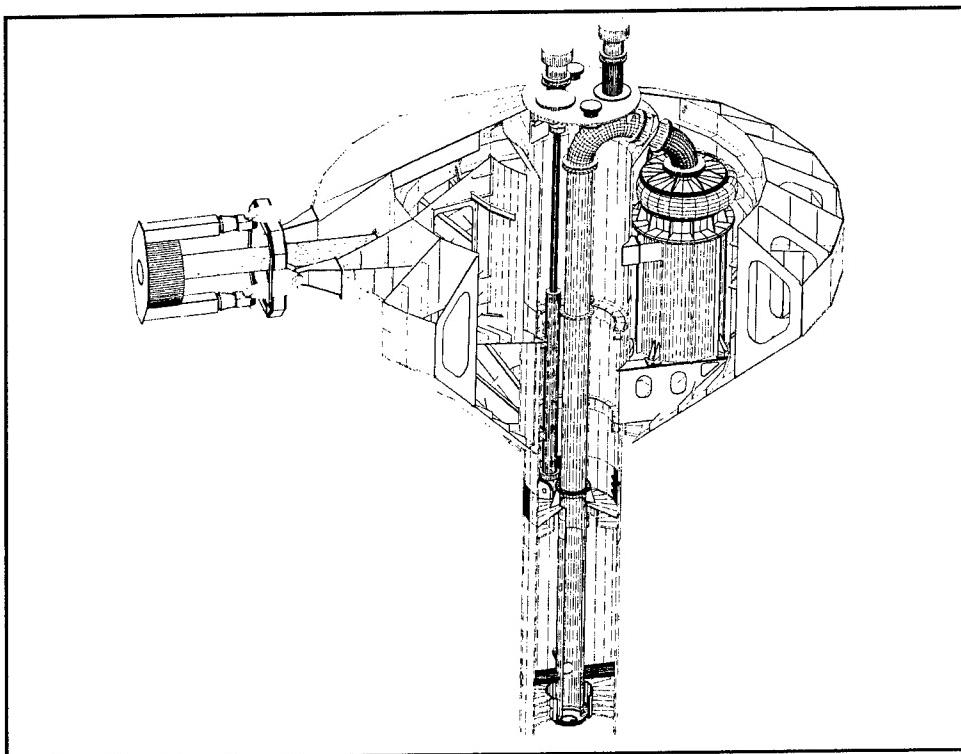


Figure 4. PUNAISE schematic (Pinpoint Dredging Company 1999; used by permission)

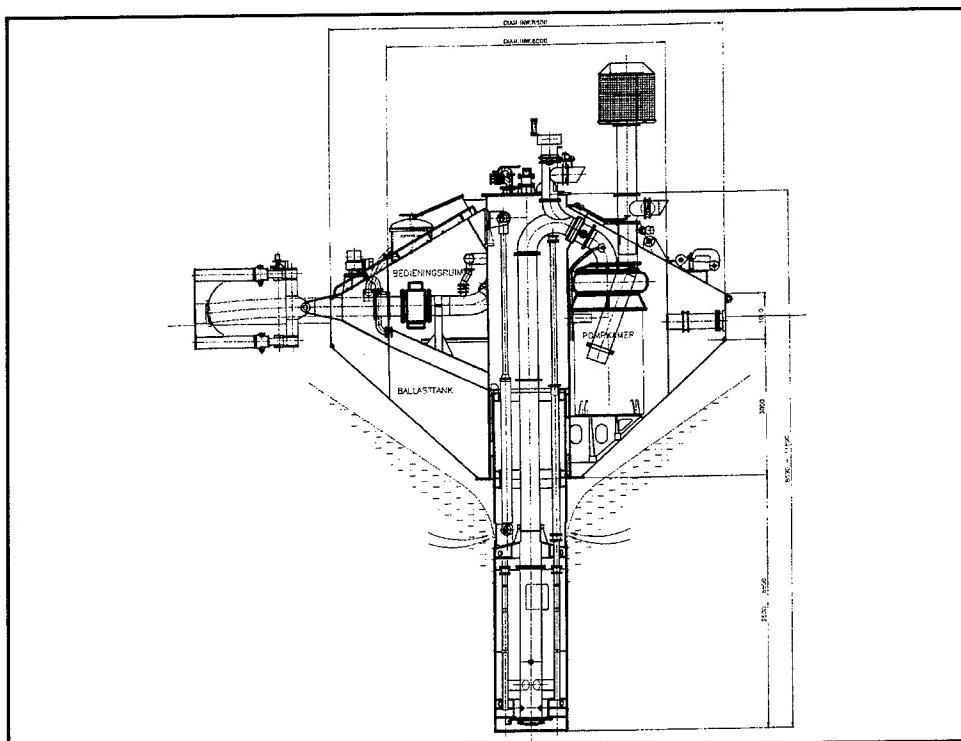


Figure 5. PUNAISE - sideview schematic (Pinpoint Dredging Company 1999; used by permission)

ing distances to about 1,000 m of the shoreline for maximum production. To achieve economical production, about 10 m of sediment is required. The PN 250 has a pump capacity of 800 m³/hr (1,046 yd³/hr). The PN 400's pump capacity is 2,400 m³/hr (3,140 yd³/hr).

Current usage

The PUNAISE has been demonstrated successfully on three projects in The Netherlands during the mid-1990s: Bloemendaal, Zandvoort, and Heemskerk.

Potential application

The PUNAISE dredging system has potential application at the following sites:

- a. Grays Harbor, Washington, for beach nourishment for an area south of the south jetty (Seattle District, Corps of Engineers).
- b. Disposal area "E" at the Columbia River, Oregon, and at the Washington entrance bar. Area "E" is an open-water hopper dredge disposal site that mounds up during normal hopper dredge disposal operations. Using the PUNAISE, material could be placed in northerly locations to enhance natural beach replenishment activities (Portland District, Corps of Engineers).
- c. Marshland creation in conjunction with a dredging sediment catch basin in the Southwest Pass of the Mississippi River (New Orleans District, Corps of Engineers).
- d. Various beach protection locations along the east coast between New York and Florida (New York District, Philadelphia District, Wilmington District, Jacksonville District, Corps of Engineers).

Cost

Unit costs per cubic yard of sediments excavated with the PUNAISE range between \$3.00 and \$4.50.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Hopper Dredge Recirculation System

Background

The European community has developed a system to recirculate hopper dredge overflow water to the draghead in a closed system to increase production efficiency and reduce surface turbidity plumes resulting from conventional hopper overflows. Instead of allowing the overflow (composed of fine organics and transport water) to go directly back into the water, the new system pumps the overflow along the dragarm to the draghead to assist in suction operations. Reusing overflow water in this manner maintains a closed system so that only a minimal turbidity plume is produced and potential contaminated sediment is not discharged. Both IHC, Holland and Krupp Foerdertechnik of Germany have developed the recirculation system technology.

Technology

The basic technology involves reuse of transport water overflow as both pressure water and transport water in the suction head of a closed cycle system. This new technique has three main benefits: (a) minimization of sediment/turbidity clouds on surface water by avoiding transport water overflow and a possible related water pollution problem, (b) increased material flow in relation to transport water, which in turn increases dredge efficiency by reducing loading time, and (c) decreased pressure drop inside the draghead, which reduces dredge pulling force. This reduces energy needed for propulsion and lowers fuel consumption.

The main purpose of traditional technology (i.e., pumping beyond overflow) is to increase dredge load density as much as possible by settling out dredged materials and allowing transport water to flow back to the surrounding waters. A simple rule of thumb to determine if the new recirculation system will be effective on a particular job is to make sure that the bottom materials have a density greater than 1,300 g/l. This allows materials to settle out and increases dredge load density. Materials with lower density tend to remain in suspension longer and generally do not settle out during the dredge's economic loading time.

Current usage

The hopper dredge recirculation system has been successfully affixed to the dredge NAUTILUS. It has also been installed on Boskalis Westminster's new jumbo trailing suction hopper dredges (23,347-m³ capacity), the WD FAIRWAY, and QUEEN OF THE NETHERLANDS. These dredges have successfully met high expectations regarding their overflow systems.

Potential application

This technology would be useful to private industry as well as the Corps and could result in cost savings of millions of dollars. Currently, the Corps is planning to convert the dredge McFARLAND to state-of-the-art design with respect to dredging technology under the Repair, Alteration and Modernization Program (RAMP). The Corps recognizes that the recirculation system retrofit has definite merit.

Cost

The exact cost for retrofitting the McFarland with a recirculation system is undetermined as yet but the benefits are tremendous. The retrofit could entail replacing hull connections, trunnions, dragarms, davits, and winches as well as providing additional pumping capacity. A rough estimate for the cost of the retrofits is \$2 million.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

DOP Submersible Dredge Pumps

Background

De Groot Nijkerk of Nijkerk, Holland, has successfully developed a series of submersible dredge pumps called DOP pumps. The DOP pump has many advantages: it is compact, easy to use, and very suitable for restricted working areas; it is capable of very accurate dredging; has a large production capacity due to high mixture concentration; has virtually unlimited suction depth; is easily transportable; and easy to attach to an excavator, crane, or mudcat.

Technology

The DOP pump is based on existing and well-proven dredge pump design. However, by applying a mechanical seal as shaft sealing instead of the conventional gland, gland water and grease are superfluous. The benefits of the DOP pump include: simpler maintenance, greater deployability, and, due to the lack of extra piping, greater reliability. The impeller is clamped to the pump shaft by means of a tension set. The DOP pump is driven by a hydraulic or electric motor placed directly on the pump. The DOP can be outfitted with various suction mouths such as a cutter unit, jet water ring, dustpan, or auger.

Current usage

The five types of DOP pumps on the market today have been used successfully at various dredging job sites throughout Europe and other parts of the world.

Potential application

The DOP pumps could be used in the United States by a number of Corps Districts to:

- Clean harbors, channels, marinas.
- Clean locks.
- Clean sediments behind dams at great depths.
- Clean impounding reservoirs.
- Empty barges.
- Remove silt layers.
- Remove sediments adjacent to pilings, docks, and wharves.

Cost

The cost of a DOP pump varies depending on its size and the requirements of the job. However, unit cost per cubic yard of material pumped compares favorably to conventional pumping costs.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Pivoting Gearbox

Background

IHC Holland has developed a very successful pivoting gearbox that now makes it possible to drive a dredge's ladder pump directly while the support diesel engine remains horizontal (Figure 6).

Technology

From an energy and efficiency point of view, a pump on the dredge ladder directly driven by a diesel engine is far better than either the hydraulic or electric submerged pump drives most common on the market today for

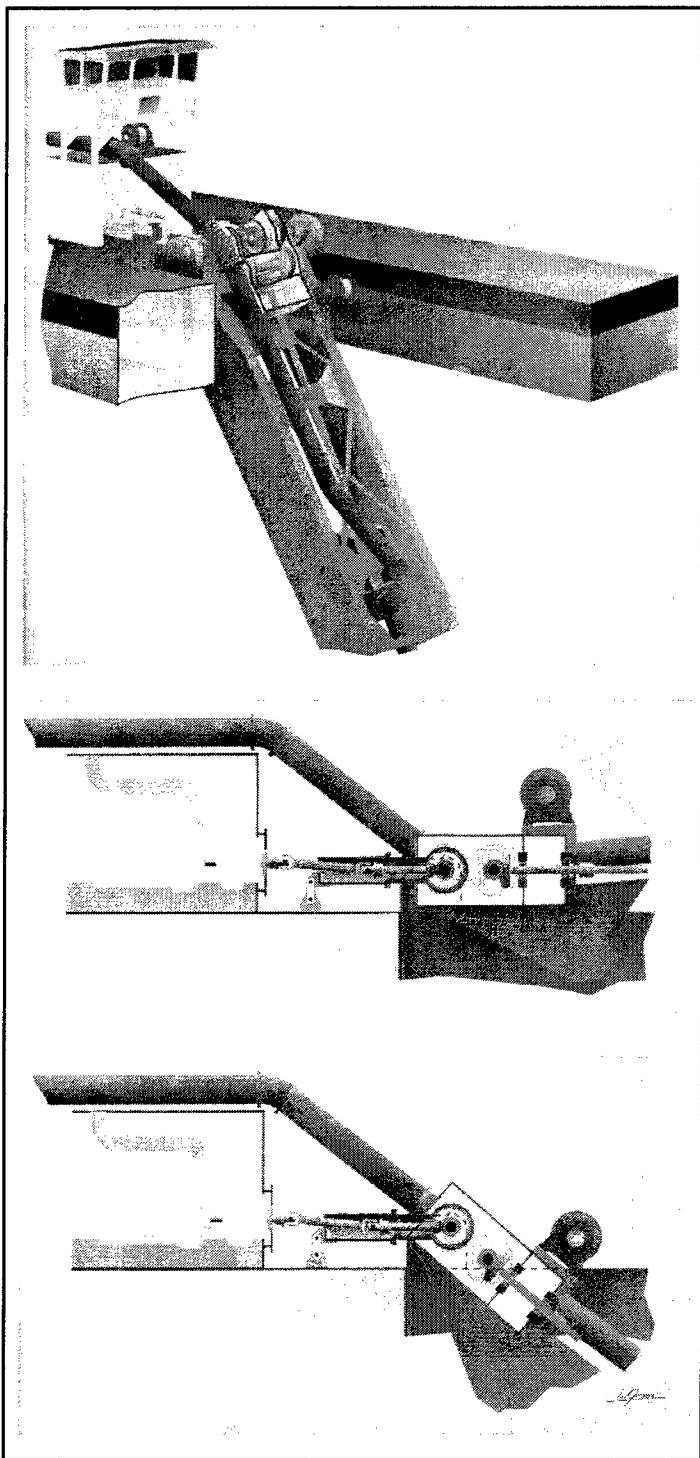


Figure 6. Patented IHC pivoting gearbox for direct drive of ladder pump (IHC Holland 1999, used by permission)

deep dredging operations. To be able to accomplish this, the diesel engine had to be capable of continuous operation at an approximate angle of 45 deg, because bothering with all sorts of universal joints was too complicated. In addition, the engine had to be flexible enough so that at full throttle it would run at 80 percent of maximum RPMs. The pivoting gearbox is an energy-efficient solution that does not have the disadvantages of the inclined diesel engine, universal joints, and lack of RPM flexibility. The advantages of the gearbox are numerous: minimal energy loss, increased production and reduced downtime, simple control through the diesel engine's revolutions, reliability and durability, increased safety as the engine room is on deck and there is no dredge pump down in the hull, and location of the complete dredge pump power on the ladder.

Current usage

At least 15 dredges have been built in the last several years fitted with a direct drive using a pivoting gearbox.

Potential application

The pivoting gearbox could be used effectively on all of the Corps' dustpan and cutterhead dredges. Installation would take place during the next scheduled major overhaul on any of the dredges being considered for major repairs or upgrading.

Cost

Cost of the pivoting gearbox is not known at this time.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

High-Efficiency Dredge Pumps

Background

Both IHC Holland and Krupp FØrdertechnik, in agreement with Georgia Iron Works (GIW), have developed high-efficiency dredge pumps in order to meet demands for greater production output than conventional pumps.

Technology

High-efficiency pumps have been used since October 1995 and are installed on more than 10 dredges. The high-efficiency pumps improve suction characteristics, reduce wear, and improve production. Efficiency has been increased by 20 percent at the same power output as conventional pumps. Computers were instrumental in improving the hydraulic properties of dredge pumps.

The high-efficiency pump's double-torqued blades and the fully rounded suction shield combine to significantly improve suction characteristics and make the pump less susceptible to cavitation. Consequently, there is an improvement of flow through the entire pump, which in turn reduces wear. Since pump impellers are a single-cast unit, they are not usually repaired but are replaced when worn out. For maximizing abrasion resistance, wear casings and impellers are made of patented high-chromium white iron for the Krupp/GIW pumps.

Current usage

High-efficiency dredge pumps have been installed on many of the European dredges constructed in the last several years. This includes the "jumbo" dredges similar to the QUEEN OF THE NETHERLANDS ($23,347\text{-m}^3$ hopper capacity).

Potential application

High-efficiency dredge pumps have the potential for application at the following sites:

- a. Installation on Corp's Hopper Dredge McFarland under Philadelphia District's anticipated Repair, Alteration and Modernization Program (RAMP).
- b. Installation on any of the Corps dredges including hopper dredges, cutterhead dredges, and dustpan dredges. Installation would take place during the next scheduled dredge pump replacement over-haul.

Cost

Costs of new high-efficiency dredge pumps are not known; they have a remarkably short investment payback time.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

The SedErode Measurement System

Background

SedErode (Figure 7) is a field instrument for measuring the erodability of cohesive-based sediment in its natural environment. SedErode applies a known hydrodynamic force (shear stress) to the sediment surface while monitoring the response of the sediment in terms of sediment release (concentration), from which the critical erosion shear stress can be determined. This parameter (shear stress) is a key factor when considering sediment transport problems and engineering design. The results are used to successfully predict the erosion behavior of natural sediments and to establish a relationship between erosion shear stress and density. This instrument was developed and is used by HR Wallingford, of Wallingford, England.

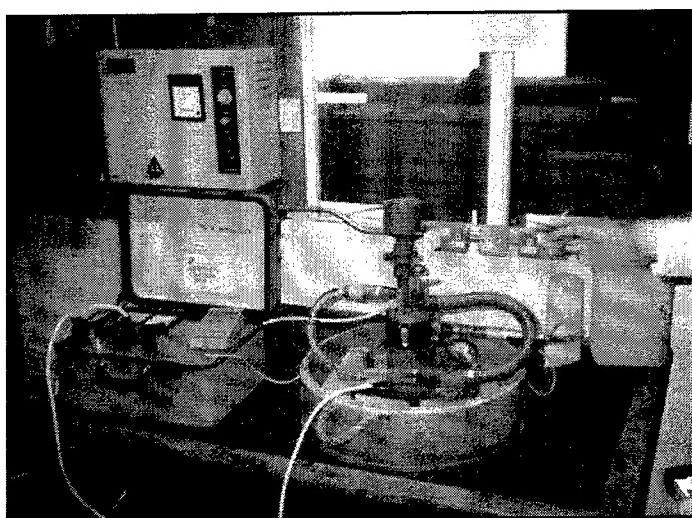


Figure 7. HR Wallingford SedErode unit
(HR Wallingford 1999, used by permission)

Technology

The SedErode unit, consisting of a head unit and control box, is portable and self-contained. The head unit consists of a 40-cm-diam circular base plate. The base plate has a short, thin wall tube underneath, and a pump and chamber mounted on top containing a reservoir, flow diffuser, and pump connections. The chamber is also fitted with filling and venting ports. To use, the thin wall tube is pressed into the sediment until the base plate rests on the surface. The pump is started and water is recirculated slowly over the surface of the sediment. The flow rate of the pump is gradually increased until the turbidity starts to increase. The shear stress can then be read directly or test results can be logged to produce the erosion characteristics of the sediment. Outputs from SedErode include the shear stress and the turbidity associated with the stress.

Applications of the SedErode include sedimentation studies, real input for modeling and design, monitoring of sediment features, and environmental assessment. The system is suitable for intertidal mudflats and coastal fringes, rivers, lakes, reservoirs, sewers and urban drainage systems, disposal ground on land and at sea, dredging and reclamation of any muddy-based sediment. The system currently operates in the dry, with optimized results obtained from intertidal areas during low tides. To determine submerged marine sediment characteristics, the sediment must be brought to the surface and placed on a special sampling plate designed for the SedErode system.

Current usage

SedErode provides real-time measurements with results in less than 10 min and has been used for over 6 years at 18 different European sites. Operation and readouts of the SedErode are easily obtained.

Potential applications

SedErode has the potential for application at the following sites:

- a. Evaluation of dredgeability and erosion studies of dredged materials. SedErode could be used to verify the stability of fine-grained sediments used for capping of contaminated sediments. It could also be used to determine whether material placed in an offshore disposal area will migrate from an ocean disposal site.
- b. Other potential uses include bank stability analyses, determination of season and duration effects, assessment of sediment changes after placement, and verification/analysis of the stability of dredge deposits.

Costs

Currently, the instrument can be contracted.

Purchase price is approximately \$16,000 (US).

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Nearshore Shelves

Background

Rijkswaterstaat, the government agency in charge of navigation channels in The Netherlands, has begun to utilize nearshore placement techniques using conventional bottom dump dredges to place material in the nearshore for beach nourishment. Several shorelines along the North Sea of The Netherlands have been experiencing erosion for some time.

Beginning in 1990, the Dutch government has concentrated on 'soft' engineering solutions such as beach nourishment. Since 1990, approximately 4 to 6 million m³/year have been placed on the beaches. Most of the sediment was placed via hopper dredge pumpout operations.

In an effort to reduce operating costs and place more beach-quality sand in the littoral system, the Rijkswaterstaat conducted an experiment in

1997 to place 1 million m³ in the nearshore zone. Analyses of wind, sediment, and wave patterns determined that the optimum location, i.e., within the active movement of the beach, was between the 3- and 7-m contour. However, practical safety and operating limitations of the dredges required the material be placed between the 5- and 8-m contour.

Technology

The initial experiment proved to be very successful, with all placed material remaining within the littoral system after 1 year. In 1998, 3 million m³, half of all the material used for beach nourishment in The Netherlands, was being placed in the nearshore zone and not directly onto the beach. To construct the shelf successfully, the dredge must be equipped with doors that open sequentially, usually bow to stern, and open in increments. At the 8-m contour, the dredge begins to open its doors and reduces the bottom elevation to approximately 5 m while reducing the dredge's draft. As the dredge moves closer to shore, it opens the bottom doors wider, releasing additional material until the dredge reaches the original 5-m contour. The dredge fills the site until the bottom between the original 8-m and 5-m contour is filled to a depth of 5 m.

One placement cycle takes between 6 and 12 min. To place material in shallower water, the rainbow technique is used (a nozzle located in the bow of the vessel used to spray the material up to 50 m closer to shore). Studies of the placement technique have shown that the sediment migrates shoreward and remains within the littoral system. The Rijkswaterstaat currently contracts with dredge operators annually; dredges are selected on the basis of size, draft, hopper volume, costs, and availability. Contracts are often structured around ongoing maintenance dredging, so that the beach nourishment can be conducted during favorable weather conditions, and the dredge can haul maintenance dredge material to the North Sea while returning to the beach nourishment location with beach quality sand. Combining projects greatly reduces overall costs.

Potential applications

Currently the Corps constructs nearshore berms at several locations with great success and cost savings. Most of these operations have been limited to using split-hull hopper dredges. Construction of the nearshore shelves indicates that there are applications for dredges with sliding doors to participate in nearshore placement operations as well, increasing competition. In addition, hopper dredges that can incrementally and sequentially open bottom dump doors could be used to place sand caps on contaminated material.

Costs

Current estimates in The Netherlands indicate a cost of \$1.5/m³ for the nearshore placement, with haul distances of up to 17 km.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Sand Separation Techniques

Background

There are different levels of contaminated soils within the river and estuarine systems of industrialized Europe. Many of the contaminated materials have medium to large percentages of sand associated with the finer-grained contaminated materials. Due to limited disposal areas and the high cost of handling contaminated materials, many countries employ sand/silt separation techniques. The Netherlands requires that sand be separated from the fine-grained fraction when handling contaminated materials. Several methods have been developed, ranging from simple to complex.

Technology

One of the separation systems is located in Hamburg, Germany, along the Elbe River. In 1993, the Metha plant (Mechanica Treatment of Harbor Sediments) began separating the coarse and fine-grained fraction of contaminated sediments dredged from the Elbe River (Detzner et al. 1998). Figure 8 shows the operating principle of the plant. Dredged materials are temporarily held in a 300,000-m³ holding basin, and then material passes through a coarse fraction (larger than 80 mm) bar sizer to reduce clogging downline. Two hydraulic dredges are then used to pump the sediment through a rotary screen to remove particles greater than 10 mm. The sediment then passes through hydrocyclones to separate the coarse fraction. Sediment greater than 63 microns is separated from the fine-grained fraction, and the sand passes through an ascending flow separator to remove the remaining fine particles, as well as other debris. The sand is next processed through a vibration screen to reduce moisture content to between 10 and 15 percent.

To complete the process with fine-grained sediments, flocculants are added to decrease settling time; the remaining contaminated material is processed through a series of presses to reduce the water content to 45-percent solids. The contaminated sediments are then placed in one of two silt hills or used in the manufacture of bricks (ETH Unwelttechnik 1998; Harms 1995). The plant is designed to handle between 700,000 and 800,000 m³ annually of the 2 to 3 million m³ dredged annually from the Elbe River.

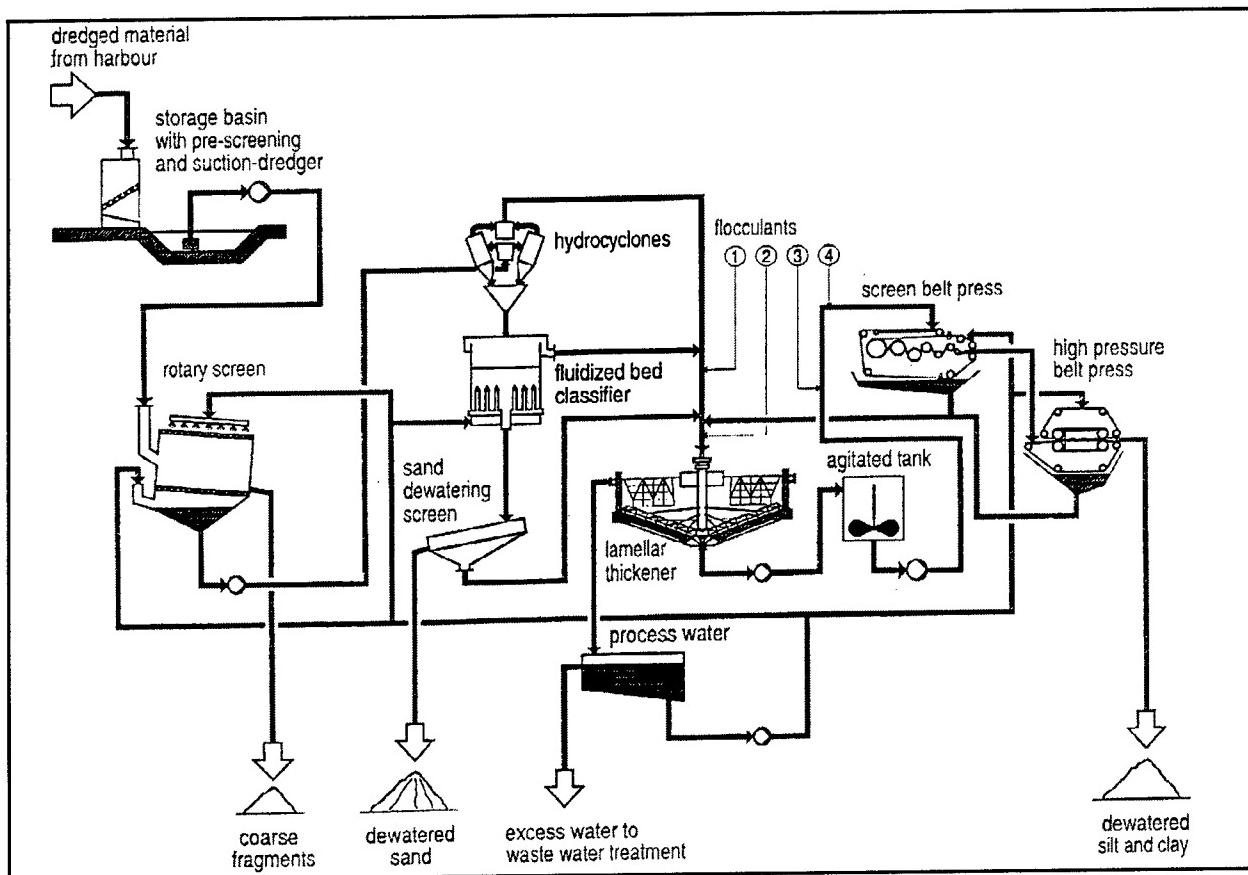


Figure 8. Sand separator schematic Heinz-Dieter Detzner 1999; used by permission)

Cost

Plant construction costs were approximately \$74 million, with annual operating expenses of approximately \$22 million. Plant construction costs included a water treatment plant and construction of the silt hill.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Technology

Smaller portable plants similar to the Metha Plant have been constructed and are operational at many locations. One example is the treatment facility run by Boskalis-Dolman (Figure 9). The plant is designed

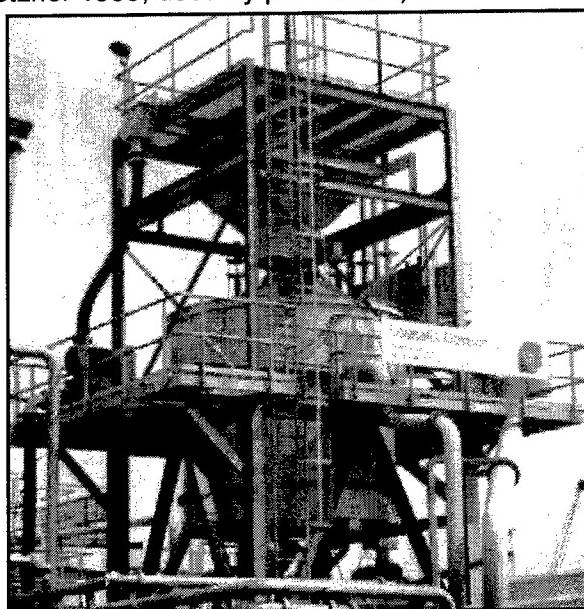


Figure 9. Portable separation system (Boskalis-Dolman 1999, used by permission)

to handle between 150,000 and 200,000 m³ annually. The sediment is put through a separation process similar to the Metha Plant process with few exceptions. The advantage of this plant is that it is portable and can be moved to project sites.

Cost

The cost is about \$35/m³ of sediment treated. This cost can vary depending on the contaminant of concern, grain size distribution, and the amount of trash within the system. The \$35 includes all costs to the user (no additional charges for containment or sale of materials are included).

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Technology

Another example of successful separation of sand from the silt fraction was conducted at De Slufter in The Netherlands. This project was completed in 1987 to contain contaminated sediments dredged from the Port of Rotterdam. The 260-hectare site has a capacity of 100 million m³ (see Figure 10). In an effort to retain as great a capacity as possible, sand is separated

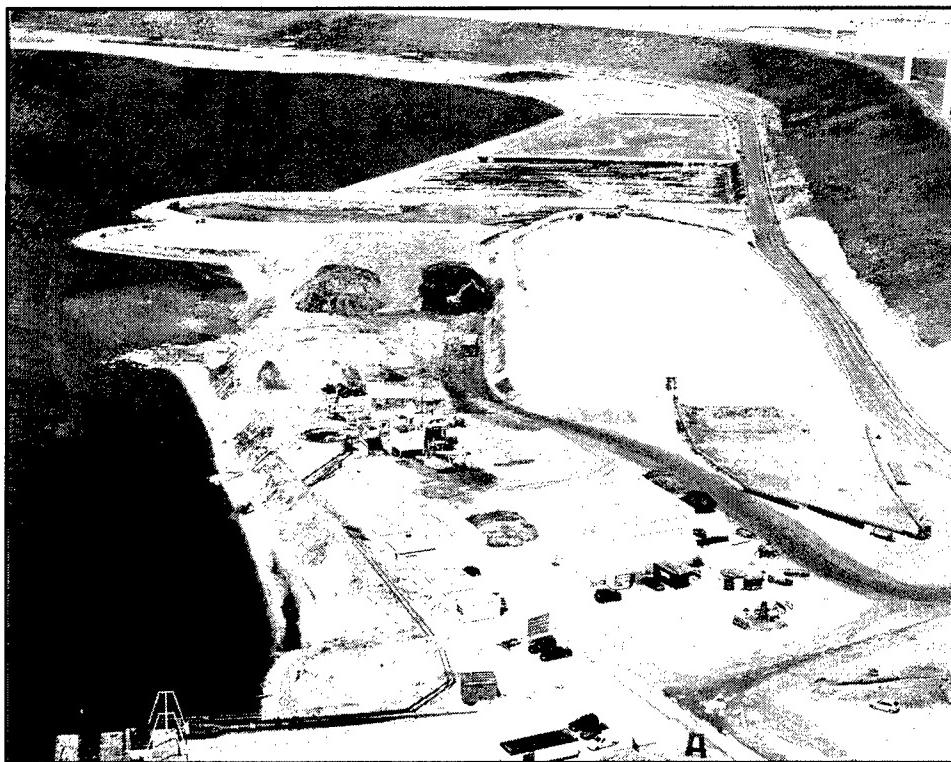


Figure 10. De Slufter at Port of Rotterdam. Part of the De Slufter disposal site (left) area, where tests are carried out for beneficial reuse (center and right) (Port of Rotterdam 1999, used by permission)

from contaminated silts on a routine basis. De Slufter managers have continuously looked for innovative approaches to sand reclamation. They are currently investigating several different methods including a silting basin and hydrocyclones. A sand separation basin is employed that is sized for the velocity and quantity of material coming into the site. A small, confined area at the De Slufter site expands in the direction of flow to allow settling time for sand so that fine-grained materials remain in turbulent suspension and are allowed to flow into De Slufter. The sand basin is periodically emptied and the sand is used for industrial purposes.

Hydrocyclones have also been employed to separate sand from fine-grained materials at De Slufter. According to the managers, hydrocyclones represent 80 percent of the cost while supplying 20 percent of the sand; the sand separation basin represents 20 percent of the cost, while supplying 80 percent of the sand separation. Operators at De Slufter are currently experimenting with a device called a "sand peeler." The sand peeler is a rectangular section of discharge pipe with a flap in the bottom section (Figure 11). The peeler is designed to make use of the natural zone separation that occurs within the pipe to separate the flows. The flap is adjustable to account for different flow regimes and sediment characteristics. The flap is intended to separate the flow into two streams and, if successful, will allow for in-pipe separation of sand and silt fractions. At the time of this investigation (July 1998) experimentation had not begun.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Potential applications

Sand separation can be conducted as described above. All methods listed are for reduction of contaminated materials and are not intended for sand production. Sand has value as a by-product, but not enough value to overcome the costs associated with separation and dewatering. Real-time, in-pipe separation of dredged materials was not observed. The sand peeler may prove effective in separating flow regimes; results of this study should be available within a year. For locations with a large area capable of relocating sand, the sand basin may save space in the disposal area and provide recoverable sand reserves.

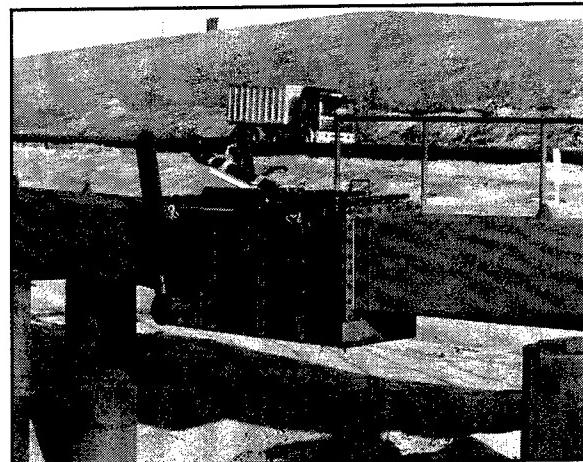


Figure 11. Sand peeler (Port of Rotterdam 1999, used by permission)

River Vanes

Background

The River Waal is one of the larger river branches that make up the Rhein River delta system. The river supports commercial navigation from the Port of Rotterdam into Germany and France. The river's bedload is primarily sand, with most of the shoaling occurring in bendways or mid-channel in the form of sand waves. Several nondredging techniques have been used to control shoaling in the river. The techniques include: armoring the outside slope to force flow into the interior bank; groins, both emergent and submerged, to train flow to the centerline of the channel; and submerged, midstream vanes that reduce spiral flow near the river bottom to diminish scour on the outside bank and decrease deposition on the inside bank. Many of these techniques have been used in river systems throughout the United States except for the mid-river vanes (see below).

Technology

The vanes are sheet-pile driven into the river bottom to help control the flow lines of the river, stabilizing the bendway by reducing the tendency of the river to erode the outside bank while depositing on the inside bank. Spacing, elevation off the bottom, and depth of burial are all dependent on river dynamics and desired outcome. Approximately 1 million m³ of material is dredged from the river each year. This amount is estimated to be one half to one third the amount required for removal to meet authorized dimensions if nondredging techniques were not used.

Potential applications

River vanes may be cost-effective for high-velocity rivers such as the Columbia or the Mississippi. Vanes could reduce shoaling through bendways; however, underkeel clearance must be considered for navigation safety. Interviews with Rijkswaterstaat staff indicate that safety issues and navigation concerns have been studied and proper clearance requirements developed.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Detailed Shoaling Analyses

Background

Detailed analyses of the physical processes that occur in and around the ship channel, coupled with a detailed analysis of dredging effectiveness by season can provide approaches to reduce overall dredging volumes and/or the need to dredge. At two locations within the United Kingdom (UK), port authorities conducted such analyses that have had a major impact on the routine maintenance required by the facilities. In England, the port authorities are solely responsible for maintenance of their navigation channels. Funding, contracting, or conducting the work is a port function. Several ports have acquired dredges with crews, and conduct their own dredging, while others choose to contract out their required maintenance. The two examples used here are the Tees and Hartlepool Port Authority and the Harwich Haven Port Authority. The Tees and Hartlepool Port Authority conduct almost all of their own dredging with a private plant, while Harwich Haven Port Authority contracts out its dredging needs.

Technology

The Port of Tees and Hartlepool is located in the northeast section of England. The Port Authority (Port) currently conducts a majority of its own dredging with two trailing suction hopper dredges. The Port has taken a proactive approach to shoaling analyses to identify patterns and, when possible, to reduce overall dredging requirements. Currently, berths are dredged deeper than authorized channels so that deep-draft vessels can come and go on high tide and remain at the dock during low tide. Dredging is coordinated with the vessels that are calling on the port. For example, dredging is conducted in the shallowest area if a deep-draft vessel is calling on port; otherwise, high shoaled areas are dredged. With this kind of flexibility, the Port can and does assign dredging operations daily.

A careful analysis of the Port's projects indicates that the majority of shoaled material originates from the North Sea and is transported up the navigation channel by tidal action. The Tees River does not have a large flow volume compared to flushing from the large tidal range of 3 to 5 m. The analysis was developed over three broad areas. First, a detailed hydrodynamic and sedimentation study was conducted on the area to determine the sources of shoaling and flow patterns in the channel. Second, modifications were made to the dredging operations, and third, the effectiveness of the modifications were monitored.

Prior to the analysis, a majority of the dredging was conducted in the upper portions of the channel and at the mouth. Sediment dredged in the upper sections of the channel was placed in the midsections, near the S curves, where dredging was not required. Since the midsection did not need dredging, little consideration was given to the fate of this material. It was determined that much of the material placed in the midsection of the channel was migrating back to the upper portion, recycling the maintenance material. The Port identified several actions which could help re-

duce overall dredging requirements. The actions included: (1) eliminating overflow of the hopper dredges, (2) transporting all dredged sediments to the North Sea, (3) eliminating the practice of in-channel placement, and (4) concentrating all dredging at the mouth of the channel. Before making changes, the Port operated two full-time crews on each dredge. Since taking action to reduce dredging, the size of the crews have been cut in half and operation time has been cut almost in half. The Port has been able to reduce its overall dredging requirement significantly, and is able to operate with the same budget it had 10 years ago.

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Technology

The Harwich Haven Port Authorities is located in Harwich, along the western shore of England. It is a rapidly expanding port that deals primarily in ferry traffic and container terminals. The container portion of the port channels has been expanded in all dimensions (wider, deeper and longer) several times within the past 10 years, resulting in increased maintenance requirements. Harwich is similar to Tees with a majority of the shoaled sediment originating from the North Sea. The sediment is primarily fine silts and clays. Ambient water conditions are so turbid that the port facility routinely has water column turbidity levels of 300 mg/l.

To better understand the effectiveness of dredging and how to reduce dredge requirements, the Port conducted an analysis of the relationship between dredging production and tides in the port facility. The detailed analysis indicated that the best dredging production was obtained during neap/spring tides. Figure 12 shows the relationship between tidal range, dredged volume, and removed volume (total survey volume) for May 1996. During these relatively slack tidal periods, the effectiveness of the dredge is reduced as material quickly backfills the project. Figure 13 shows the same information for a tide event in February 1997. Comparison of the tidal events indicates that dredging conducted during February 1997 was more effective in removing material from the channel than the May 1996 project. The primary difference between the two was the tidal range, with an additional difference of 1 m in February 1997.

To take advantage of this knowledge, Harwich developed a contract where hopper dredges are available on demand to dredge during peak tidal ranges. Dredging occurs four to five times a year depending on need. The Port enters into a contract for an 18- to 24-month period with the above-mentioned requirements. The specification also requires the hopper dredge to operate in thin cuts at speeds up to 5 knots to supply the required amount of material to the draghead. The contractor has several rates for payment (by day if production is low, unit price for high production, and hourly rates are also available). The Port estimates that current costs are approximately \$1.0 to 1.25/m³ (US). Figure 14 shows the decrease of dredge volume over the past 4 years by implementing the above management technique.

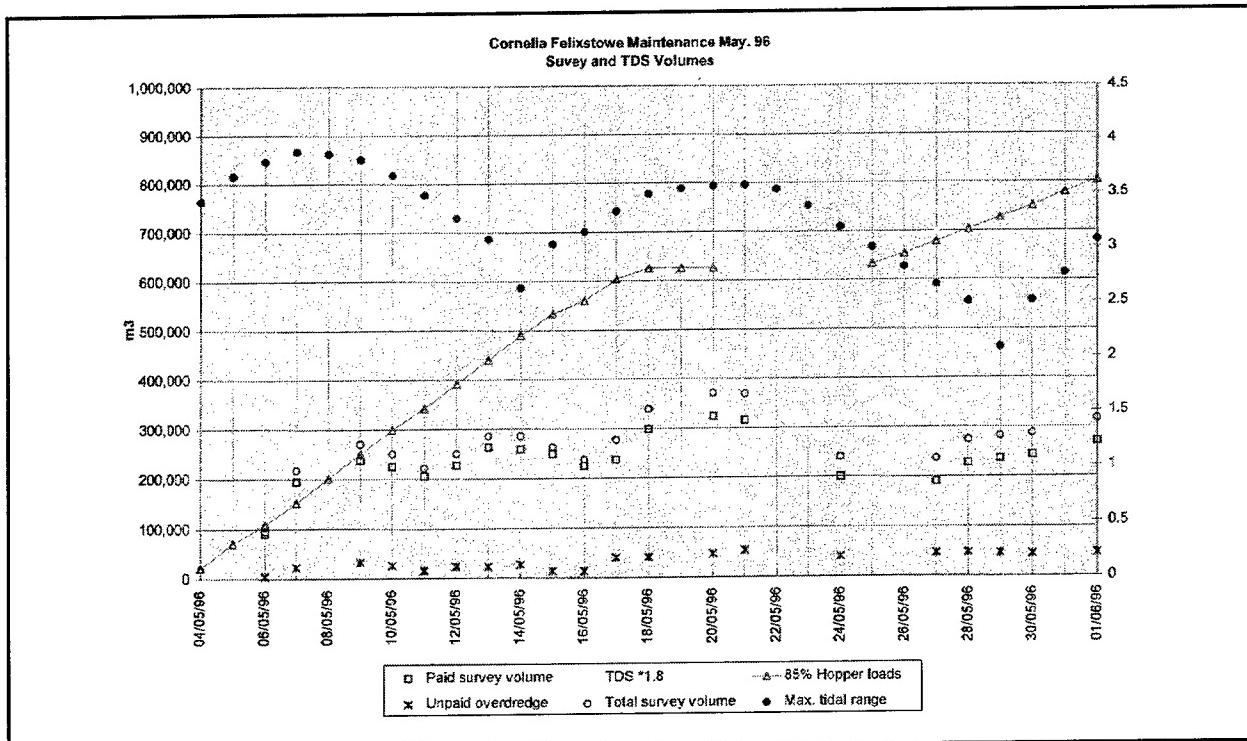


Figure 12. Survey and TDS volumes, May 1996 (Harwich Haven Port Authorities 1999; used by permission)

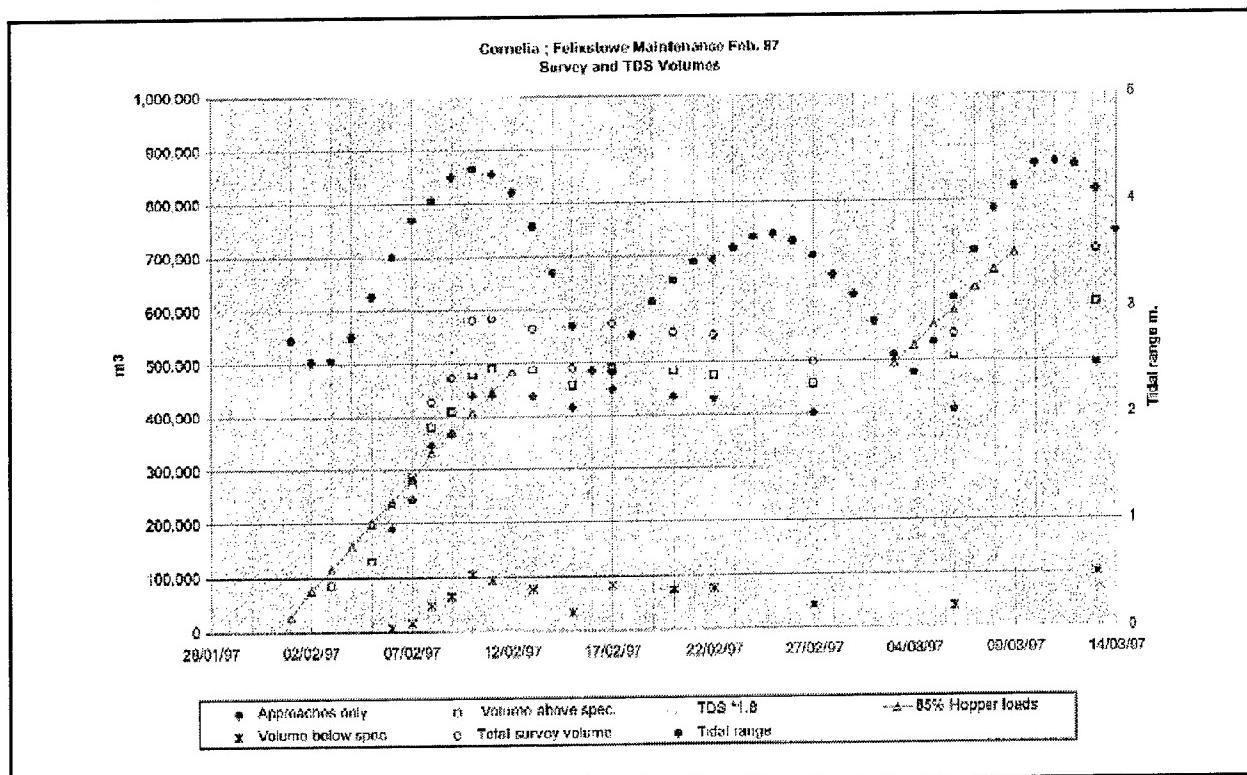


Figure 13. Survey and TDS volumes, February 1997(Harwich Haven Port Authorities 1999; used by permission)

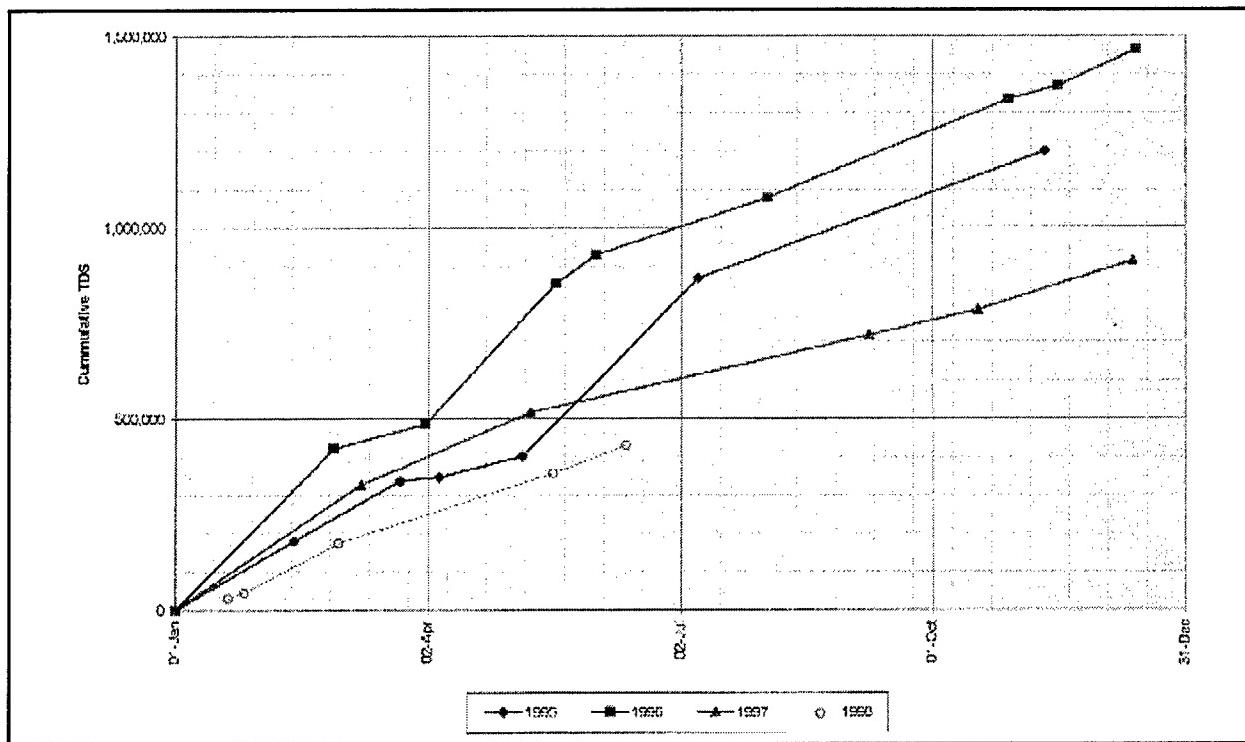


Figure 14. Decrease of dredged volume (Harwich Haven Port Authorities 1999; used by permission)

Company/Organization(s): Access restricted to U.S. Army Corps of Engineers.

Potential applications

Detailed shoaling analysis has the potential for application at the following sites:

- Lower sections of the Mississippi River.* Currently, when the Mississippi River is rising, usually in the spring, it requires many of the dredges working in the Gulf and east coast to meet the demand. This disrupts other dredging contracts and reduces overall competition during high-water periods. With more accurate prediction and scheduling, prices could be reduced and a more predictable schedule could be developed which would reduce the impact on other dredging operations.
- Freeport Ship Channel.* The offshore bar at the Port of Freeport often requires emergency dredging due to rapid shoal formation. Shoals usually occur in spring or summer. Better prediction techniques would allow for better lead time and would reduce the need for emergency dredging.

Cost

Determination and prediction of sedimentation rates can be as simple as effective surveying and analysis as well as complicated computer model simulations. Costs for these processes vary greatly and potential benefits should determine the level of sophistication needed before starting any analyses.

5 Other Technology Reviewed

The other technology reviewed is displayed in this section in alphabetical order.

Acoustic Measurements of Suspended Soils
Application of Hydrocyclones for Maintenance Dredging Operations
Aquatic Vegetation Removal
ATB (Articulated Tug/Barge Unit)
Automated Disposal Surveillance System (ADDIS)
Automated Sludge Removal With High-Density Dredger
Beach Nourishment Measurement and Payment
Cement and Soft Mud Mixing Technique Using Compressed Air-Mixture Pipeline
Centrifuge Dewatering
Cleanup Dredges - Thin Layer Removal of Contaminated Sediments
Computerized Dredging
Computerized Maintenance Management System
Coral / Rock / Concrete Excavator
Custom Turnkey Hydrographic Package
Deep Dredging
Delivering Dredge Slurry Through Long Pipelines
Development of an Active Mass Damper for Stabilizing Loads
Suspended on a Floating Crane
Developments in Submerged Dredge Pumps and Their Drives
Dredge Performance Indicators for Monitoring Cutterhead Dredging Operations
Dredge Plant Management Program - Port of Rotterdam, The Netherlands
Dredge Production Monitoring
Dredge System Innovations
Dredging and Backfill Operations in a Hostile Environment
Dredging in Unexploded Ordnance (UXO) Contaminated Sediment
Economic Decision Framework for Estimated Benefits and Costs of Sediment Remediation
Eddy Pump

Environmental and Geographic Information System for Dredge Control
Estimating Contaminant Losses During Dredging
Feasibility of Capping Industrial Waste Disposal Sites with Dredged Material
GLOBALtechs : SEDTEC / REMTEC
Greasemaster
Heavy Duty Bucket to Dredge Rock
Hopper Dredge Recirculation System
Improve Hardfacing Procedures
Improved Bioassay Testing Procedures
Improved Methods for Correlating Turbidity and Suspended Solids
Innovative Capping Procedures - Puget Sound Region
Innovative Design of a Multiport Diffuser
Instrumentation for Clamshell Buckets
Instrumentation for Hazmat Dredging Projects
Interface Detector
LADS - Lightweight Aggregate from Dredged Sediment
Large-Scale and Economic Dredging by World's Largest Grab Dredger
Long-Term Maintenance Dredging Contracting Procedures in Belgium
Low-Turbidity Dredgehead Designs
Method of Measuring and Managing Turbidity on Dredge Projects
Modern Hydraulically Operated Grab Buckets
Monitoring, Control, and Automation of Mechanical Dredges
Mo-Slip Ball Joint Liner
New Automation / Instrumentation Systems for Dredges
Onsite Confinement of Contaminated Dredged Sediments
Overboard Access Retrieval System (OARS)
PC-based Geographic Information System (GIS) for Design and Management of Disposal Sites
Portable Berm
QUEEN OF THE NETHERLANDS - State-of-the-Art Jumbo Hopper Dredge
Redesigned Clamshell and Grapple Buckets
Ro-Boom - Easily Deployed Silt Curtain
Scoop Dredger, Sweep Dredger, Back Hoover
Seabed Classification
Short Chain Ladders
Siltmeter
Software Ship Inspection Safety
Spill Monitoring System
Stabeach
State-of-the-Art Multibeam Sounding Equipment
Stockton Bucket
Sub-Bottom Profiling to Delineate Areas of Contaminated Sediments
Submerged Dikes to Control Sedimentation
Submersible, Transportable Utility Marine Pump (STUMP)
The Silent Inspector System

Treatment of Copper-Contaminated Marine Sediments
Use of Physical Models to Develop Shellfish Excluder Device
Use of Small Auger Dredge to Reduce Turbidity
Vacuum Clamshell Bucket
Viscous Excavator (Rotary Dredge Cutterhead)
Water Injection Dredging (WID)
WINOPS Real-Time Dredge Positioning Software

Acoustic Measurements of Suspended Soils

Category: Operating Procedures

Description: A reliable method has been developed for the measurement of suspended solids concentrations using Acoustic Doppler Current Profilers (ADCP) in addition to its design capability of measuring current speed and direction. This method has been used to study sediment plume generation and decay around dredged material disposal operations in Europe and Asia, in addition to studies of natural sediment transport.

The application of Doppler current profilers in measuring suspended solids concentrations during dredging operations are described. Also included are the system limitations, accuracy, and data processing procedures descriptions.

Current usage:

- 1) Sediment plume generation during water injection dredging at Kohlfleet Basin in the Port of Hamburg.
- 2) Plume generation during disposal operations. Dredge disposal from trailing suction hopper dredges in Hong Kong and UK.
- 3) Plume generation during disposal operations. Barge disposal in Germany and Hong Kong.
- 4) Natural sediment flux in River Mersey, UK.

Despite some limitations arising from instrument design and performance and the extent to which site conditions may influence measurements, the combined measurement of suspended solids concentration and current speed and direction using ADCP's has been developed to the point where a high degree of accuracy can be obtained. The method permits large-scale, dynamic sediment transport processes to be quantified at a level of detail that is difficult to achieve using other methods. This approach has been used to study the migration and decay of sediment plumes and dredged material disposal.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Location: Various sites throughout UK, Europe, and SE Asia

Information Sources:

Literature: Title: "Acoustic Measurement of Suspended Solids for Monitoring of Dredging and Dredge Material Disposal"
Author: J.M Land, R.N. Bray
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 105

Interviews: Interviewee: Rick Sheets
Interviewer: Cal Woolley
Interview Date: 9/22/98
Interview Location: Telcon

Interviewee: M.R. Palermo
Interviewer: Cal Woolley
Interview Date: 9/22/98
Interview Location: Telcon

Application of Hydrocyclones for Maintenance Dredging Operations

Category: Pipeline/Discharge Systems

Description: Hydrocyclone technology has typically been used for aggregate separation in the mining industry. The feasibility and coordination of integrating hydrocyclone technology with maintenance dredging activity has been investigated at Canaveral Harbor, Florida by the ACOE Jacksonville District (CESAJ). A local sponsor, the Canaveral Port Authority, asked CESAJ to investigate the possibility of applying hydrocyclone technology in the Canaveral Harbor maintenance dredging project to increase the volume of dredged material suitable for beach and/or nearshore disposal. A small workshop was convened January 4 and 5, 1994 by CERC/CEWES and CESAJ to further assess requirements and capabilities of the hydrocyclone application at Canaveral Harbor.

Hydrocyclones have been primarily used for the separation of different density or weight materials within a slurry mixture. The hydrocyclone has no moving parts and requires relatively low energy to perform its primary function. Hydrocyclones function efficiently with slurry concentrations of about 20 percent solids by weight. Solids concentrations range from 5 to 50 percent.

For maintenance dredging applications, hydrocyclone operation can be isolated from the primary dredging operation. A hydraulic unloader can be used to slurry the dredged material from a scow, where it can be hydraulically pumped to screen off debris, then processed through the hydrocyclone to separate out unwanted material until underflow material suitable for beach nourishment (i.e. greater than 74 microns) is acquired.

Other potential applications

- 1) Beach nourishment.
- 2) Reduce volume for upland disposal applications.
- 3) Contaminated sediments.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Title: "Coordinating the Feasibility of a Dredged Material Separation System using Hydrocyclones for Canaveral Harbor, Florida"
Author: Deborah Heibel, Mitch Granat, Mark Wolff
Month: 11
Year: 1994
LitType: Report/Proceedings
Publisher: Dredging 94
Publication: ASCE, New York, New York
Address:
Page: 38

Interviews: Interviewee: Deborah Peterson
Interviewer: John Lally
Interview Location: Tel Con 904 232-2204

Aquatic Vegetation Removal

Category: Dredge Plant

Description: The versi-dredge is a portable hydraulic dredge fitted with a special "weedmaster" cutterhead to remove hyacinth and other vegetation from a pond or lake. It is self-propelled with a Starwheel drive system (patent pending). It can also dredge bottom sediments as a conventional small hydraulic pipeline dredge.

The versi-dredge equipped with a weedmaster cutterhead can clear 2 to 4 ha per 12-hr work day depending on the density and maturity of weed population. It cuts weeds into 8- to 10-cm lengths so they can be pumped through a discharge pipe. It is more effective than mechanical dredges.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Michoacan Lake, Mexico

Comision Nacional Del Agua (C N A)

Comments: Temporary removal only. Weeds will grow back.

Information Sources:

Literature:

Title:	"An Efficient Hyacinth Harvester"
Month:	December
Year:	1997
LitType:	Periodical
Publisher:	World Dredging Mining & Construction
Publisher Address:	PO Box 17479 Irvine, California 92623
Publisher Phone:	714 553-0836

ATB (Articulated Tug/Barge Unit)

Category: Navigation/Positioning Systems

Description: A tug/barge combination in which the tug is secured in a notch located in the stern of the barge, by one of several mechanical systems. The system allows some freedom of motion between the tug and barge with the predominant one being relative pitch about the Y axis. All systems restrain the roll of the barge providing an easier ride in heavy seas. Other features include:

1. ATB can be quickly disconnected. Does not require a dedicated tug as does an ITB (integrate tug barge) system.
2. Less hydrodynamic drag than conventional towed barge systems, faster, less fuel consumption.
3. Safer than conventional towed barge systems.
4. Good seakeeping/control up to 12-ft seas (have survived 48-ft head sea). Currently 27 units in service for oil, aggregate, and cement transport. No bottom dump or split hull barges in service currently.

Potential application: Large dredging projects requiring long hauls to the dump site in the open ocean.

Outfitting cost would depend on size. Could cost up to \$1,000,000 per unit.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Automated Disposal Surveillance System (ADDIS)

Category: Production Monitoring

Description: SAIC has developed a state-of-the-art, low-cost system for accurate monitoring of scow position and draft during (1) loading at the dredging site, (2) transit, and (3) disposal, regardless of location. Data can be acquired in near real-time via ARGOS satellite or during service trips to the scow(s). SAIC also offers full data processing, GIS mapping services, and Graphical User Interface systems to aid operations managers and regulatory agencies in rapid assessment of disposal operations and information-based decision making. USACE has participated in development of the ADDIS system, which is in operation at a number of Districts, including NYDISS (New York Disposal Surveillance System), an automated unit for dredged material disposal monitoring in the New York Harbor area.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Dredged Material Disposal Monitoring Program - USACE - New York District

Location: New York Harbor

Completion Date: Ongoing

Project Contact: Brian May

Information Sources:

Literature: Title: "ADISS"
Author: SAIC
Month: December
Year: 1997
LitType: Brochure
Notes: Brochure supplied by SAIC

Internet: Internet Address: www.adissdata.com
Internet Search Date: 8/18/98 3:05:01 PM

Automated Sludge Removal With High-Density Dredger

Category: Dredge Plant

Description: The dredger "Shin Ohmoto Maru" is equipped with a newly developed, input/output balance type sludge collector to suck sludge by negative pressure, an automatic controller, and kick-spud-type position control equipment. Combined with an operation control system to maximize the dredger's performance and a GPS-aided construction control system, the vessel is capable of performing efficient, high-density, automated dredging, while digging to design depth.

The fully automated control system is operated by two computers, consisting of four systems, each responsible for control of:

- 1) Suction pump.
- 2) Sludge discharge pump.
- 3) Swing speed.
- 4) Advance by kick spuds.

The control systems for the sludge discharge pump and the advance by kick spuds can work independently.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Lake Kojima

Location: Lake Kojima, Japan
Completion Date: 1996 -2003
Comments: The Shin Ohmoto Maru has removed 220,000 m³ of sludge from the lake as of 12/97.

Information Sources:

Literature: Title: "Automated Sludge Removal By Using High Density Dredger"
Author: S. Hara, Y. Hayase, H. Fujisawa, T. Hara, S. Satoh
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 163

Beach Nourishment Measurement and Payment

Category: Surveying

Description: This beach nourishment project involved placement of 1,920,000 yd³ of beach fill material obtained from the Folly River behind the island, along 8,600 m of shoreline. The project had a singular construction window in the winter between November 1, 1992 and May 15, 1993.

The template geometry for the beach renourishment was dynamic, rather than static, holding constant the total number of cubic yards of fill for each linear foot of advance. This approach, while rendering the final fill quantity more finite and predictable, substantially complicated the placement of the fill material, and the computation of the pre- and post-dredge surveys.

A unique survey data collection system, the "surfboat," was used to acquire nearshore survey data. The "surfboat" consisted of a 6-m broad-beam skiff equipped with dual-frequency (24/208) echo sounder, and Del Norte Microwave positioning system. The unique feature of the surfboat was the method by which heave was compensated for. A Spectra-physics plane laser was placed above a point of known elevation, and a height instrument taken from the point to the infrared light beam. As data were collected, a differential between the bottom of the receiver mast and the point at which the receiver mast was intersected by the beam was recorded. The differential measurement, combined with the known distance from the bottom of the mast to the face of the transducer and the depth measurement, defined the vertical component of the measurement as an elevation related to the project datum. This feature made additional reduction unnecessary.

Note: Survey boat, valued at \$50,000, capsized and sunk during the operation. No one was injured

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Folly Beach, Beach Nourishment Project

Location: Folly Beach, South Carolina
Completion Date: May 1993
Project Cost: \$8,200,000
Estimated Cost: \$5,000

Information Sources:

Literature: Title: "Beach Nourishment Project at Folly Beach, SC"
Author: Billy L. Edge, Patric Johnson, and Charles W. Granger
Month: 5
Year: 1994
LitType: Report/Proceedings
Publisher: WEDA XV
Page: 255

Cement and Soft Mud Mixing Technique Using Compressed Air-Mixture Pipeline

Category: Dredged Material Disposal
Environmental Dredging
Pipeline/Discharge Systems

Description: A cement-mixing method using a compressed air-mixture pipeline for soft mud conveyance has been developed for effective and economical disposal work. Plug flow generated in the pipeline and compressed air are used to mix cement-based solidifier with mud in the pipeline. Uniform cement mixing is achieved by injecting solidifier into an expander pipe with a larger diameter than the pipeline.

The cement and soft mud mixing technique using the compressed air-mixture pipeline is a prospective method for solidification of large land areas at low cost. It is usable at reclamation sites that have previously required use of a new mixing barge in combination with the large capacity compressed air-mixture pipeline transfer system. The technology is currently in the research and development phase.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Cement & Soft Mud Mixing Technique Using Compressed Air-Mixture Pipeline"
Author	Akinori Sakamoto
Month:	June
Year:	1998
LitType:	Report/Proceedings
Publisher:	WODCON XV, Las Vegas
Page:	251

Centrifuge Dewatering

Category: Sediment handling
Description: Dewater dredge sediments using centrifuges in conjunction with flocculents. Mechanical dewatering is being evaluated for dredging projects as a result of the following factors:

- Confined sediment placement sites within a reasonable distance of dredging area are increasingly unavailable.
- Beneficial uses for dredged sediment, such as a daily cover at landfill operations or as a soil amendment, require dewatered material.
- Many landfill sites require that dredged sediments be dewatered prior to acceptance for disposal.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Capitol Lake

Location: Olympia, Washington
Completion Date: 1995
Project Contact: Greg Hartman

Lake Lawrence

Location: Thurston County, Washington
Completion Date:
Project Contact: Greg Hartman
Comments: The Lake Lawrence Restoration Project involved shallow lake dredging of fine sediments with high water and organic content. The purpose of dredging was to eliminate the largest source of phosphorus loading into the lake in order to alleviate an excess macrophyte problem. The project scope included sediment characterization for physical and chemical characteristics, evaluation of lake treatment alternatives (i.e. dredging or capping sediment) and impacts, evaluation of disposal alternatives, and preparation of detailed cost estimates for all alternatives. Hydraulic and mechanical dredging with various types of dredge equipment were evaluated for final design. Equipment selection was based on both economic and production factors. Disposal alternatives evaluated included retention facilities with enhanced settling techniques and sediment dewatering and land application of sediment slurry as a beneficial use.

Information Sources:

Literature: Month: August
Year: 1996
LitType: Periodical
Publisher: World Dredging and Mining Construction
Page: 16
Notes: See Nancy Case's paper from WEDA 1996. Includes references and diagram of centrifuge system.

Cleanup Dredges - Thin Layer Removal of Contaminated Sediments

Category: Contaminated Sediment Handling
Dredge Plant

Description: Ketelmeer project involves removal of up to 20 million m³ of polluted silt from a 350-hectare lake. Pollution is Class 4 (highest rating in Holland), including heavy metals, PAC, PCB, etc. Project includes removal of polluted silt, 20- to 40-cm thick, and capping with 0.5 m of clean sand. Special heads (scoophead, sweephead) were used to provide accuracy, minimum spillage, and low turbidity.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Ketelmeer

Location: Holland
Completion Date: Longterm - compl 1/4 21 Century
Comments: 1. Dredged sediment will be treated; therefore low water entrainment is important. Project photo on back cover. More info - World Dredging 1997, p 10.
2. Numerous descriptive brochures are available.

Information Sources:

Literature: Month: August
Year: 1996
LitType: Periodical
Publisher: World Dredging Mining & Construction
Publisher Address: PO Box 17479 Irvine, California 92623
Publisher Phone: 714 553-0836
Page: 6
Notes: This project was also reported in *Sea Technology*, March 1998.

Computerized Dredging

Category: Computerized Dredging System

Description: Automated dredge sweeps lagoon without supervision. Programmable controllers used to automate the process. Hydrostatic drives are used to propel dredge and drive the dredge pump.

Application:
In use on sludge pond applications.
Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Month: December
Year: 1996
LitType: Periodical
Publisher: World Dredging Mining & Construction
Publisher Address: PO Box 17479 Irvine, California 92623
Publisher Phone: 714 553-0836

Computerized Maintenance Management System

Category: Equipment Maintenance

Description: Dynastar 2000 Computerized Maintenance Management System. Version 2.0, is focused on the enterprise-wide management team and provides enhanced real-time search capabilities. Based on client/server architecture using flexible SQL database. Designed for Windows 95 and Windows NT platform. Is Year-2000 compliant.

This system provides the user with a maintenance and spare parts database, maintenance procedures and scheduling data, parts inventory, reorder points, and vendors.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Management Software"
Month:	June
Year:	1998
LitType:	Periodical
Publisher:	World Dredging and Mining Construction
Page:	25

Coral / Rock / Concrete Excavator

Category: Dredge Plant

Description: Hydraulically driven transverse rotary cutting head capable of operating under water. Can adapt to a wide range of drives. Available in 30, 60, 120, 250 kW sizes.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Month: December

Year: 1997

LitType: Periodical

Publisher: World Dredging and Mining Construction

Page: 25

Notes: Transverse rotary vice axial rotary cutter heads are more efficient in rock or coral dredging situations.

Custom Turnkey Hydrographic Package

Category: Geotechnical Evaluation Methods
Measurement & Payment Methods
Navigation/Positioning Systems
Production Monitoring
Surveying

Description: System can monitor and chart harbors and navigation channels. Records pre- and post-dredge surveys. Charts dual-frequency echosoundings. Runs on standard PC, or with NAVBOX hardware on small vessel in more hostile field environment.

Competitor to USACE DOSIS system.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Month: December
Year: 1997
LitType: Periodical
Publisher: World Dredging
Page: 25

Deep Dredging**Category:**

Dredge Plant

Operating Procedures

Description:

Developments in types of equipment required for deep dredging. Dredge depths of up to 112 m have been accomplished at :

1. Norfra Pipeline Crossing, interconnector gas pipeline between Bacton and Zeebrugge
2. Chek Lap Kok and Changi Airport, Hong Kong

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Chek Lap Kok and Changi Airport, Hong Kong

Norfra Pipeline Crossing, interconnector gas pipeline between Bacton and Zeebrugge

Information Sources:**Literature:**

Title: "Deep Dredging"
Author: N. Pille
Year: 1997
LitType: Report/Proceedings
Publisher: CEDA 1997

Delivering Dredge Slurry Through Long Pipelines

Category: Operating Procedures
Pipeline/Discharge Systems
Pumps

Description: The White Rock Lake, Dallas' main water supply, the largest municipal lake in the United States, will require removal of 2,630,000 yd³ of silt, debris, and vegetation . The contractor, Oscar Renda Contracting, is using an 18-in. C.S. dredge. Dredge pump is driven by a 1,500-HP DC motor. The 24-in. steel discharge pipeline is 104,000 ft long with only two booster pumps. Disposal site is an old quarry.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

White Rock Lake, City of Dallas

Location: Dallas, Texas
Completion Date: 1999
Project Cost: \$18,000,000
Comments: Diluting slurry density reduces power required to pump on extremely long discharge lines.

Information Sources:

Literature:

Title:	"Dredging Dallas' White Rock Lake"
Author:	Betty Sosnin
Month:	April
Year:	1998
LitType:	Periodical
Publisher:	World Dredging Mining & Construction
Publisher Address:	PO Box 17479 Irvine, California 92623
Publisher Phone:	714 553-0836

Development of an Active Mass Damper for Stabilizing Loads Suspended on a Floating Crane

Category: Dredge Plant
Safety Procedures

Description: The Shirashima Oil Storage Terminal is a floating offshore tank yard for storing 5.6 million kl of crude oil. The eight storage vessels are shielded from sea waves by breakwaters.

Verification tests at sea on actual floating crane equipment with an active mass damper system confirmed that actuation of the system would reduce to roughly 1/2 the oscillation of sling frame. These results contributed to the ease and safety of the caisson shackling operation under the wave forces.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Shirashima Oil Storage Terminal

Location: Offshore Kita-Kyusha, Japan
Completion Date: May 1998

Information Sources:

Literature: Title: "Development of Active Mass Damper for Stabilizing the Load Suspended on a Floating Crane"
Author: I. Iwasaki, K. Tanida, S. Kaji, M. Mutaguchi, S. Yamada
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 1051

Developments in Submerged Dredge Pumps and their Drives

Category: Pumps

Description: The following innovations have been developed amongst European dredge designers and manufacturers:

Electric Drives

- Low-speed, oil-filled, asynchronous submerged motors have been developed to drive ladder pumps. These are thyristor-controlled, frequency-regulated, AC motors. The motors provide improved control and durability.

Mechanical Drives (Pivoting Gearbox)

- A pivoting gearbox is located above the ladder trunnion pin on the main deck. This arrangement allows mechanical shafting to be used to connect a prime mover, located on the main deck, to a ladder pump. Its advantages include:

- 1) Eliminates need for a submerged, electric or hydraulic drive motor for the ladder pump.
- 2) Mechanical shafting provides greater power transmission efficiency.
- 3) Makes the single dredge pump (ladder pump) arrangement feasible for smaller dredges. This represents a significant cost savings over the conventional ladder and main pump arrangement.
- 4) Reduces manning and maintenance costs.

This equipment is commercially available and in service throughout Europe and Asia.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Month:	June
Year:	1998
LitType:	Report/Proceedings
Publisher:	WODCON XV, Las Vegas
Page:	137

Dredge Performance Indicators for Monitoring Cutterhead Dredging Operations

Category: Production Monitoring

Description: Development of Dredge Performance Indicators (DPI) for measuring the productivity and operating efficiency of cutterhead pipeline dredges as a function of time and location in the project area.

The DPI consists of two components:

- 1) A modeling component, which predicts dredge efficiency and percent solids transported by the dredge.
- 2) A field data acquisition component, which provides real-time data on actual solids transport and dredge efficiency.

Dredge models and the DPI data from the production meter will provide immediate feedback and historical data on cutterhead dredging operations. A PC, along with data acquisition hardware and software, can be used to log the data, perform real-time data analysis, and produce tabular and graphical reports as the dredge is operating. Case studies using the DPI have been carried out. Historical DPI data will provide insight into dredge operating characteristics based on project design criteria and aid in improving dredge process numerical models.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Dredge Performance Indicators for Monitoring Cutterhead Dredging Operations"
Author:	Stephen H. Scott
Month:	June
Year:	1998
LitType:	Report/Proceedings
Publisher:	WODCON XV, Las Vegas
Page:	1001

Dredge Plant Management Program - Port of Rotterdam, The Netherlands

Category: Operating Procedures

Description: The Port of Rotterdam has developed a real-time management program for pieces of dredging plant working in Rotterdam Harbor. The system includes real-time updates of dredge operating systems, production rate, location, draghead settings, bin operations, etc., and incorporates the latest survey data in an interactive computer-based system. The system is run from a central office in the port that allows the port managers to give real-time directions to dredge operations. The port enters into 5-year contracts with dredging companies. Payment is by hopper density, not tons dry solids. The Port employs silt traps to increase efficiency and has done extensive studies to identify contaminated versus clean sediments. Clean sediments are placed back into the North Sea, with contaminated sediments going to a confined disposal site. The Port has a real-time silent inspector type system working. The system is completely integrated with remote links so that real-time review of dredging operations can take place.

Reviewer: B. Hopman

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Rotterdam Harbor

Location: Rotterdam, The Netherlands
Project Contact: Ongoing

Information Sources:

Interviews: Interviewee: J.W. Zwakhals, Manager Dredging Division
Interviewer: Neil McLellan, Bob Hopman
Interview Date: 7/22/98
Interview Location: Rotterdam, The Netherlands

Field Investigations: Location: Rotterdam Harbor
Date: 7/22/98
Photos: Yes
Photo Location: Hartman Consulting Corporation, Bellevue, WA

Dredge Production Monitoring

Category: Production Monitoring

Description: IHC Systems provides electronic products for IHC. They have developed several tools for improving the efficiency of dredging and dredge monitoring. IHC Systems have standard equipment such as transducers, DGPS multibeam survey equipment, and dredge simulators for training dredge operators. For hopper dredges, it is standard procedure to mount transducers to determine the depth of cut and angle of cutterhead/depth of cut for each dragarm. Multibeam transducers within the dredge allow for real-time surveying of the bottom before and/or after the dredge has made its cut. Several hopper dredges have multi-beam systems placed in the hull to conduct real-time management. Dredge simulators are used to train dredge operators and determine the operating limitations of some dredges (i.e., how accurate can a backhoe operator be when dredging contaminated materials).

Reviewer: N. McLellan

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Interviews:
Interviewee: Arie Korevaar
Interviewer: Bob Hopman, Neil McLellan
Interview Date: 7/28/98
Interview Location: Sliedrecht, Holland

Field Investigations: Date: 7/28/98

Dredge System Innovations

Category: Dredge Plant
Production Monitoring
Pumps

Description: Krupp designs and builds all types of dredges, and dredging equipment. Four primary dredging innovations were discussed during the visit: the recirculating dragarm system, the dual-bucket wheel, the flexible spud system for working in higher waves while dredging offshore, and high efficiency pumps. The recirculating water system takes the overflow from a hopper dredge and returns it to the draghead. This system reduces turbidity and increases sediment concentration in the hopper. The system has increased hourly production by 20 percent in South American and Asian projects.

The dual-bucket wheel allows for efficient cutting for both starboard and port swings of the cutter. A flap installed at the inflow pipe trains the water to come only from the side the dredge is cutting.

The flexible spud allows cutterhead suction dredges to operate in larger swells. The spud is set on a rotating pin and is stabilized with cables to allow more flexibility of the spud. This design allows more relative motion between the spud and the dredge's hull, thus reducing the stress on the spud and increasing the working range of the dredge.

Krupp has also developed high-efficiency pumps for dredging operations. The pump's main innovation is the single unit cast impellers. The impellers are curved to allow for better flow through the pump, and reduce the overall wear on the impellers. Since the impellers are a single cost unit, they are not usually repaired but only replaced when worn.

Reviewer: N. McLellan

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Location: European, South African, and Asian Projects

Information Sources:

Interviews: Interviewee: Dieter Giersch, Eric Ruder
Interviewer: Neil McLellan, Bob Hopman
Interview Date: 7/24/98
Interview Location: Lubeck, Germany

Field Investigations: Location: Lubeck, Germany
Date: 7/24/98
Photos: Yes
Photo Location: Hartman Consulting Corporation, Bellevue, WA

Dredging and Backfill Operations in a Hostile Environment

Category: Production Monitoring
Description: The Boston Rivers Project involved the construction of 55 diffusers on the ocean bottom, 10 miles offshore in Massachusetts Bay in 110 ft of water. The \$93-million project for the MWRA was undertaken as a joint venture of J.M. Cashman, a marine contractor from Massachusetts, and Interbeton, a subsidiary of the Dutch HBG Group.

The project consisted of dredging, boring of vertical shafts, installation of risers and precast diffusers, and armor rock placement. What is applicable to Corps dredging projects offshore is beach restoration projects involving offshore borrow sources.

The work platform for the majority of the project construction was the Dredge "Lyons." The Lyons is 120 ft in length, with a 55-ft beam, and a draft of 10 ft with 5 ft of freeboard. Stability analysis of the dredge indicated that the rig could withstand a 3- to 4-degree roll from either starboard or port, which was tested many times throughout the project duration. Stability from bow to stern was adequate, provided the dredge was pointed into the direction of the wave attack. The dredge was moored to the seafloor with a five-point anchor configuration.

A Project Installation Manual was used to provide strict quality control procedures for the following:

1. ROV (remote observation vehicle) inspections.
2. Bathymetric surveys.
3. Dredging.
4. Protective dome movements.
5. Backfilling and landscaping.
6. Grout skirt placement.
7. Grouting of casting and skirts.
8. Underwater assembly of HPDEX domes.
9. Repairs to diffuser coating.

The project team monitored weather forecasts through faxes (commercial and public) to continually modify schedules to maximize production.

Dredging was limited to sea conditions of less than 4 ft. The dredge used a computerized positioning system, developed by SAIC, based on the Del Norte Range Range Microwave system.

At the heart of the project was the heave compensation system. The TSS 320b heave compensator was used. Bathymetric survey activities were central to dredging and backfill material quality control. Bathymetric surveys were used to determine the existing seabed elevation.

Reviewer: J. Lally

Projects Completed:

Boston Risers Project

Location: Massachusetts Harbor, Massachusetts
Project Contact: Carlos Pena
Estimated Cost: \$93 million

Information Sources:

Literature:

Title: "Dredging & Backfill Operations in a Hostile Environment"
Author: Carlos Pena
Month: 10
Year: 1995
LitType: Report/Proceedings
Publisher: WEDA 16

Dredging in Unexploded Ordnance (UXO) Contaminated Sediment

Category: Operating Procedures
Safety Procedures

Description: The USACE Buffalo District conducted a demonstration dredging project in the Toussaint River, Ohio, to evaluate the operational effectiveness of a modified clamshell bucket dredging process designed to separate over screens and retrieve UXO from sediment prior to its disposal. During the 79- work-day duration of the demonstration project, 72 dredge days removed 19,000 yd³ of material from the authorized channel limits. A total of 37 pieces of ordnance, 6 of which were unexploded ordnance (UXO) were recovered from the separation screens and properly disposed of. An overall production rate of 26.8 yd³/hour or 268 yd³/day was attained by the clamshell dredge operation at a cost of \$25.34/yd³. The total demonstration production cost was \$43.15/yd³, as opposed to an average cost of less than \$5.00/yd³ for conventional dredging in this part of the Great Lakes.

The "Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet, Section 1, Sea Bright to Ocean Township" project is the largest beach restoration project ever undertaken in the United States. The borrow source for the restoration project was found to contain several types and calibers of ordnance after dredging with hopper dredges was initiated. Cleanup operations were required to locate and remove the ordnance from the beach, and Explosives Ordnance Disposal (EOD) personnel were called in several times to remove ordnance from the hopper dredge. The dredging contracts that have been awarded since this 1994 contract for both hopper and hydraulic pipeline dredges were required to install 38-mm (1.5-in.) -spaced bars on the suction intakes. The cost per cubic yard of sand delivered to the beach has not exceeded \$4.00/yd³.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet, Section 1, Sea Bright to Ocean Township

Location: Atlantic Coast of New Jersey
Completion Date: 1994-1998
Project Contact: USACE: New York
Project Cost: \$150,000,000
Estimated Cost: Nominal
Comments: The cost per cubic yard of sand delivered to the beach has not exceeded \$4.00/yd³. This may be due to proprietary contractor improvements to the dredging equipment, and the competitive bidding process.

Toussaint River UXO Demonstration Dredging Project

Location: Toussaint River, Ohio
Completion Date: October 1995
Project Contact: USACE:Buffalo
Project Cost: \$850,000
Estimated Cost: \$740,000

Information Sources:

Literature: Title: "Dredging in Unexploded Ordnance (UXO)-Contaminated Sediments"
Author: T.L. Welp, R.L. Pilon
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 481

Economic Decision Framework for Estimated Benefits and Costs of Sediment Remediation

Category: Contracting Procedures

Description: Development of an economic analysis and decision framework for estimating the benefits and costs of options for the cleanup of contaminated sediments. This is a 4 year project planned to be completed by 1998-99. The project will focus on:

- Evaluation of overall process effectiveness and costs
- Identification of benefits likely to result from sediment remediation
- Development of decision framework covering all options

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"An Economic Decision Framework for Estimated Benefits and Costs of Sediment Remediation"
Author:	Philip Keillor
Month:	5
Year:	1995
LitType:	Report/Proceedings
Publisher:	WEDA 16
Page:	1

Eddy Pump

Category: Pumps

Description: Eddy pumps provide environmentally sensitive dredging with increased efficiency, high solids transfer, and low turbidity. Applicable where hydraulic dredging of contaminated sediments with low turbidity is required. The Eddy pump is fully developed. Offered in 8-in. to 13-in. sizes. Also used for dredging under docks.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Newport Cal Harbor

Location: Newport Harbor, Orange County, California
Completion Date: Under way (9/98)
Project Cost: \$5.56 /yd³
Comments: Combined under-dock and channel dredging (1 million yd³). \$4.65/yd³ for channel dredging. (6-mile haul / hopper scow). \$13.00/yd³ for under dock dredging (50-ft reach to 10-ft. face)

U.S. Navy - Chollas Creek

Location: Chollas Creek, California
Completion Date: November 1997
Project Cost: \$2.3 million
Comments: Project started July 1997. Removed 81,000 yd³ from 20 foot channel and contaminated slip. 50,000 yd³ (clean) pumped into 1,500 yd³ dump scows with disposal offshore approximately 9 miles. 31,000 yd³ of contaminated sediment from slip area dewatered and trucked to upland disposal. Two 6-in. by 10-in. dredges used. Eddy Flow and 6-in. Terra Flow.

Information Sources:

Literature: Month: August
Year: 1997
LitType: Periodical
Publisher: World Dredging Mining & Construction
Publisher Address: PO Box 17479 Irvine, California 92623

Environmental and Geographic Information System for Dredge Control

Category: Environmental Dredging
Production Monitoring

Description: System that monitors some field data on-line and receives results from hindcast and forecast models. The system evaluates the results against a large number of environmental criteria and triggers appropriate actions. The events and actions are fully documented and stored for later analysis and as documentation for the authorities. System employs standard computer technology including Windows.

System being used at Oresund Link Project, Denmark

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Environmental & Geographic Information System for Dredging Control"
Author:	Mette Thornkilisen, Jan Dietrich
Year:	1997
LitType:	Report/Proceedings
Publisher:	CEDA 1997
Page:	17

Estimating Contaminant Losses During Dredging

Category: Contracting Procedures

Description: The Corps of Engineers has performed intensive monitoring of dredging operations for a number of sites and has correlated sediment resuspension to dredge operating characteristics, sediment characteristics, and site conditions. Mathematical formulas to estimate the mass rate of sediment entering the water column at the point of dredging have been developed for cutterhead dredges and bucket dredges. A computer program using the Windows3.1 operating system has been written to calculate and graphically display contaminant losses and water column concentrations using predictive techniques.

The program (currently named DREDGE) allows the user to enter the necessary dredge information, site characteristics, operational data, and contaminant characteristics, then calculates an array of concentration values, including suspended sediment concentrations, total contaminant concentrations, dissolved contaminant concentrations, and particulate contaminant concentrations. DREDGE is currently a module of ADDAMS, and available from WES.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Title: "Estimating Contaminant Losses During Dredging"
Author: Averett, Hayes & Schroeder
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 527

Feasibility of Capping Industrial Waste Disposal Sites with Dredged Material

Category: Capping Polluted Sediment

Description: An environmentally sound and economically efficient method for capping a typical solid waste (bauxite residue) disposal site using coastal dredged material has been investigated. Laboratory studies involving sand capping, geotextile materials, and no capping of bauxite disposal sites were performed at Texas A&M University in 1992.

Issues resolved in the research included:

1. Whether caustic liquid would travel upward through the dredged material cap or whether saline water would travel downward into the bauxite residue.
2. The effect of time on the chemistry of the two layers.
3. The rate of migration of soluble salts (if any).
4. Effect of dredged material depth, sand layer, and geotextile placement on plant growth and soil chemical properties.
5. Sufficient depth for adequate rooting system.

Only laboratory studies had been performed as of 1994.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Texas A&M Capping and Industrial Waste Disposal Sites

Completion Date: 1993

Comments: This paper reveals the advantages of doing lab evaluations before applying the cap.

Information Sources:

Literature: Month: May
Year: 1994
LitType: Report/Proceedings
Publisher: WEDA XV
Page: 236

GLOBALtechs : SEDTEC / REMTEC

Category: Dredged Material Disposal
Environmental Dredging
Environmental Monitoring

Description: GLOBALtechs, the Internet site remediation technologies directory, provides detailed technical and project information on over 600 proven international technologies. Subscribers to GLOBALtechs can access technology descriptions, project data and results, technology contacts, and cost information, all on-line. GLOBALtechs, searched via browser, keyword, or problem solver, enables subscribers to identify technologies for specific site criteria. GLOBALtechs provides pertinent, current information to both potential users and suppliers of site remediation services, without vendor or developer bias. GLOBALtechs was created from merging two databases currently commercially available: SEDTEC and REMTECTM. GLOBALtechs has also been updated and expanded to provide the latest information and most innovative technologies in site remediation. Information will occur on a continuous basis to ensure subscribers access to the newest information.

SEDTEC, the contaminated sediment removal and treatment technologies directory, was created by Environment Canada's Remediation Technologies Program (RTP) under the Great Lakes 2000 Cleanup Fund. The database contains over 250 international sediment removal and treatment technologies with detailed information about the technologies and their projects. SEDTEC is currently available in CD ROM and diskette format.

REMTEC, the site remediation technologies database, produced by Water Technology International Corporation (WTI), offers a detailed review of over 500 site remediation treatment technologies from around the world. WTI created this database to assist technology selection for site remediation projects and it is commercially available in CD ROM and diskette format.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Internet: Internet Address: Disk distributed at WODCON
Internet Search Date: 9/20/98
Internet Links: Environment Canada - Green Lane: <http://www.ec.gc.ca>; Water Technology International Corporation: <http://www.wti.cciw.com>; Ontario Centre for Environmental Technology Advancement OCETA): <http://www.oceta.on.ca>; SEDTEC Home Page: <http://www.oceta.on.ca/sedtec>

Interviews: Interviewee: Marianne Woods
Interviewer: Cal Woolley
Interview Date: 9/25/98
Interview Location: Telcon

Greasemaster**Category:**

Equipment Maintenance
Operating Procedures

Description:

Biodegradable cleaner used for ballast tank cleaning. Creates a paintable surface with no acid dipping, no sandblasting, and no hazardous chemicals. Can also be used to clean parts, tanks, engine rooms, main engine coolers, blocks, pistons, cylinder heads.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:**Literature:**

Month:	7
Year:	1998
LitType:	Periodical
Publisher:	International Dredging Review
Page:	25

Heavy Duty Bucket to Dredge Rock

Category: Dredge Plant

Description: Heavy duty basket with air rams instead of steel arms. Compressed air, supplied via hose from the dredge, powers the cylinders with microsecond, repetitive bursts of high pressure air. Nine-cubic-yard capacity bucket weighing 90,000 lb., used by Dutra "Super Scoop" on Boston Harbor deepening job, where glacial till and granite had to be removed.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Boston Harbor

Location: Boston, Massachusetts
Completion Date: 1993

Information Sources:

Literature: Title: "Revolutionary Hawco Bucket Will Break and Dig Hard Rock"
Month: February
Year: 1995
LitType: Periodical
Publisher: International Dredging Review
Publisher Address: PO Box 1487, Fort Collins, CO 80522
Publisher Phone: 970 484-9562
Page: 11

Hopper Dredge Recirculation System

Category: Dredge Plant

Description: Recirculates water from hopper dredge hopper back to the draghead.

Advantages:

- Avoids sediment clouds generated during loading process
- Reduces pulling force by reducing vacuum inside suction head
- Increases production rate

This system was built into the Hopper Dredge NAUTILUS in Germany which is currently in service in the Orient. In addition, it has been installed on the FAIRWAY and QUEEN OF NETHERLANDS (both 23,400-cm capacity).

Requires major distribution piping changes, additional piping to draghead and special draghead.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:	Year:	1996
	Publisher:	WEDA 17
	Page:	17

Improve Hardfacing Procedures

Category: Equipment Maintenance

Description: A procedure for increasing carbide concentrations in tungsten carbide hardfacing has been developed. This procedure increases the carbide concentrations from 60 to 85 percent. In changing the normal high/chrome, high/carbon hardfacing to a tungsten carbide deposit, wear life on the 30-in. cutterhead dredge PAPOOSE increased from 350,000 yd³ to 1,750,000 yd³. The process involved using a MIG carbide system, instead of a tungsten carbide electrode system. Substantially greater wear life is achieved with essentially the same material, tungsten carbide.

Another recent innovation in prolonging the life of dredge parts is the automation of hardfacing elbows and "Y's." Complete hardfacing of double 90-deg turns or S's is now possible on the inside of dredge pipes as small as 10-in. System is very inexpensive and easy to use. Hardfacing companies are located throughout the United States.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Numerous, in U.S. and Asia

Information Sources:

Literature: Title: "Two New Developments in Hardfacing Dredge Parts"
Author: J.C. "Moe" Messinger
Month: September
Year: 1997
LitType: Periodical
Publisher: World Dredging Mining & Construction
Publisher Address: PO Box 17479 Irvine, California 92623
Publisher Phone: 714 553-0836
Page: 15

Improved Bioassay Testing Procedures

Category: Operating Procedures

Description: Evaluate improved procedures for handling bioassays to reduce erroneous results. Emphasis is placed on salinity, grain size, ammonia, and sulfur dioxide effects on test results, and physical handling of test animals.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: LitType: Report/Proceedings
Publisher: WEDA 17
Page: 331

Questionnaire

Submittals: Submitted By: Cal Woolley
Date Submitted: 7/27/98

Improved Methods for Correlating Turbidity and Suspended Solids

Category: Operating Procedures

Description: Specially designed settling columns have proven useful in correlating turbidity and suspended solids for project-specific conditions. In order to correlate turbidity and suspended solids during dredged material disposal monitoring efforts on a sediment-specific basis, measurements can be used as an operational aid in monitoring dredging and disposal operations in lieu of more costly and time-consuming suspended solids measurements.

A suspension-specific TSS-turbidity correlation curve can be developed and used in the following situations as an aid in routine monitoring of a dredging operation for which TSS standards or operating guidelines have been set:

- 1) Monitoring resuspension of solids in the immediate vicinity of the dredge.
- 2) Monitoring for TSS limitation the point of compliance for open-water disposal.
- 3) Monitoring for TSS in the effluent discharge from containment area or sedimentation pond for upland disposal.

In addition, more accurate and appropriate procedures have been developed for:

- 1) Sampling.
- 2) Use of settling columns.
- 3) Correlation's procedures.

Work can be performed by any commercial soil testing lab that is equipped with settling column. Cost at WES is roughly \$5,000 per sample. Commercial soil testing labs contacted charge roughly \$3,000 for this work.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 79

Innovative Capping Procedures - Puget Sound Region

Category: Operating Procedures

Description:

Several innovative capping procedures have been developed by the USACE Seattle District for placement of sand cap over contaminated or remediated marine sediments. These systems have been developed under Corps supervision and with Corps funding:

- Sand Box Diffusers
- Uses a standard split-hull scow, pushed sideways with controlled positioning and opening.
- Washing sand off deck barge for thin layer capping.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Denny Way Combined Sewer Overflow Capping

Location: Seattle, WA

Comments: Beneficial use of Corps maintenance dredge material for the City of Seattle. Sand placed by sprinkling uniformly graded sand (~0.4mm) dredged from upper Duwamish River Navigation Project. A barge sand spreading system was used.

Eagle Harbor Superfund Capping

Location: Bainbridge Island, WA

Completion Date: 3/94

Comments: Random towed barge sprinkling and hosing sand off flat deck barges with 2,100-gpm pump. Barge speed over 3 ft/sec. Dump less than 10 cy/sec.

Pier 51 Washington Dept. of Transportation Ferry Terminal Expansion

Location: Elliott Bay, Seattle, WA

Completion Date: 11/89

Comments: Commercial sand spread with clamshell from barge

Pier 53 Capping of Outfall Area

Location: Seattle, WA

Comments: Beneficial use of Corps maintenance dredge material for the City of Seattle. Seven-compartment barge used to sprinkle uniformly graded sand (~0.4mm) dredged from upper Duwamish River Navigation Project. A barge sand spreading system was used.

(Continued)

Innovative Capping Procedures - Puget Sound Region (Concluded)

Pier 64 Capping Project

Location: Seattle, WA
Completion Date: 3/94
Comments: Beneficial use of Corps maintenance dredge material for the City of Seattle. Seven-compartment barge used to sprinkle uniformly graded sand (~0.4mm) dredged from upper Duwamish River Navigation Project. A barge sand spreading system was used. Currents measured real time at upper 1/3 and lower 1/3 depths.

Simpson Tacoma Kraft Co., Capping and Habitat Restoration Project

Location: Tacoma, WA
Completion Date: 8/88
Comments: COE Permit action. Hydraulically dredged Puyallup River medium sand was used to cap contaminated in situ sediment at pulp mill outfall and approximately 3,000 yd³ of contaminated excavation for outfall extension. Spud barge with energy dissipator was used to spread sand.

West Waterway Prototype CAD Project

Location: Seattle, WA
Completion Date: 3/88
Comments: Corps maintenance dredging. 1,100 yd³ bottom dumped into long pit, sprinkled from split-hull barge.

Innovative Design of a Multiport Diffuser

Category: Dredge Plant

Description: Design of a 200-m-long (660-ft-long) multiport outfall diffuser to minimize environmental impacts, costs, and permitting requirements. By placing the pipe on the seabed, dredging (including possible rock excavation) and dredge material handling costs were reduced. Displacement of surficial sediments by plowing will allow the creation of a suitable foundation for the diffuser pipe. The plowing technique can also meet vertical tolerance requirements for pipe placement, which will allow the diffuser to be hydraulically efficient. The use of heavy wall (non float) pre-stressed concrete cylinder (PPC) will counter buoyancy and hydrodynamic forces. Use of this pipe along the smooth profile of armor protection across the diffuser alignment will also provide adequate protection from vessel anchors.

Surface bedding material was displaced with an underwater plow, which resulted in cost savings and ease of permitting. The plow was pulled over the seabed by a barge at low speed, minimizing turbidity.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

South Essex Sewage District Outfall

Location: Salem Harbor, Massachusetts

Information Sources:

Literature:

Title:	"Innovative Design of a Multiport Diffuser"
Author:	Mindy Roberts, Bernadette H. Kolb
Month:	11
Year:	1994
LitType:	Report/Proceedings
Publisher:	Dredging 94
Publication Address:	ASCE, New York, New York
Page:	56

Interviews:

Interviewer:	John Lally
Interview Location:	Telcon

Instrumentation for Clamshell Buckets

Category: Dredge Plant

Description: Accurate bucket positioning is required when dredging contaminated bottom materials. The Cable Arm environmental bucket combines an acoustic echo ranging device and a pressure transducer, both attached to the bucket, to accurately position the bucket on the bottom. Vertical positioning instrumentation has been used on sites in the Great Lakes. The system is site-specific. Individual project site assessment, bottom profile, core sampling, water quality, and pre-survey data will be used to design the control system of the clamshell bucket. The acoustic sensors are reliable and can maintain calibration when subjected to noise, vibration, and turbidity.

The control system may be impacted by barge movements, and the lowering speed at the beginning of the clam cycle. The critical sensing target area is approximately 3 meters from the bottom, where the clamshell will pause for final sensing input. Limited horizontal movement will not interfere with the final depth average. The ability to store depth and operational data will provide valuable information to ensure that tight-tolerance dredging projects are performed successfully, both economically and environmentally.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Instrumentation for Clamshell Buckets (Environmental Dredging)"
Author:	John Lajeunesse
Month:	5
Year:	1995
LitType:	Report/Proceedings
Publisher:	WEDA 16
Page:	16

Instrumentation for Hazmat Dredging Projects

Category: Operating Procedures

Description: Advances in instrumentation can improve efficiency of hazmat dredging projects. Typical criteria and objectives for hazmat dredging projects :

1. Monitoring/Controlling Total Suspended Solids (TSS)
- OBD (optical backscatter device)

2. Monitoring Excavator Position
- GPS
- Laser positioning
- Microwave system

3. Maximizing Concentrations of Solids

- Laser Line Scan System (LLSS), instrumentation used to provide visual information to maintain optimal contact between the excavator and the hazardous material. Conceived in the 1960's. Oceaneering Technologies has been working with WES to acquire funding through CPAR for dredging related demonstrations of the LLSS's capabilities. LLSS's are manufactured by Westinghouse. The LLSS consists of two major components:

- a) Underwater pressure vessel - contains the illumination source and scanning mechanism.
- b) Topside console - Contains the signal processing equipment required to create the visual image.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Title: "Advances in Instrumentation for Hazmat Dredging Projects"
Author: Keith Lipford
Month: May
Year: 1994
LitType: Report/Proceedings
Publisher: WEDA XV
Page: 174

Interface Detector

Category: Production Monitoring

Description: The BM 24 liquid level instrument measures fluid level in open and pressurized tanks up to 40 ft with accuracy to 0.1 in. It can be modified for liquid interface detection. Operates on a float guided on nonmagnetic sealed tube. Inside the tube is a follower magnet that tracks the float. Could be used as a sensor for a hopper dredge TDM System.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Level Indicator Doubles as Interface Detector"
Month:	February
Year:	1993
LitType:	Periodical
Publisher:	World Dredging Mining & Construction
Publisher Address:	PO Box 17479 Irvine, California 92623
Publisher Phone:	714 553-0836
Page:	25

LADS - Lightweight Aggregate from Dredged Sediment

Category: Beneficial Use of Contaminated Sediments

Description: The Lightweight Aggregate from Dredged Sediment (LADS) technology is designed to provide a cost-effective and environmentally sound solution to dredging inorganic and organic contaminated sediment. The LADS system converts contaminated silt and clay dredged sediment into lightweight aggregate. Contaminants are either converted into their elemental components, caught in stack filters, or encapsulated in the aggregate.

Preliminary testing of the LADS system in the United States and a demonstration project in the former Soviet Union have been completed. Lightweight aggregate manufactured from contaminated sediment will meet the Standard Specification for Lightweight Aggregate for Structural Concrete ASTM C330, set by the American Concrete Institute (ACI). All process operations are performed on a barge, which may be attached to either a mechanical or hydraulic dredge. No upland disposal or treatment sites are needed for the remediation or disposal of contaminated sediment. The lightweight aggregate manufactured from the contaminated sediment can be sold as construction material.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"LADS System, Inc, Thermal Remediation Treatment for Contaminated Sediment"
Author:	Vladimir Shepsis, Nancy Case, Greg Hartman
Month:	11
Year:	1994
LitType:	Report/Proceedings
Publisher:	Dredging 94
Publication Address:	ASCE, New York, New York
Page:	66

Large-Scale and Economic Dredging by World's Largest Grab Dredger

Category: Dredge Plant

Description: The grab dredger "Tosho" has a dredging capacity of 6,000 m³/hr, equipped with the world's largest grab bucket (200 m³ capacity). The large dredger provides a solution to large-scale and economical dredging. It also minimizes pollution.

Large capacity and energy savings are realized by the self-contained electro-hydraulic grab bucket and the counterweight-balanced lifting/lowering system. The required power for dredging is roughly 60 percent of that for traditional bucket dredges. The dredge has a traveling spud system.

Features that make this dredge successful include:

- 1) Counterweight balance and hydraulic operation, which mainly function to balance the grab bucket weight with counterweight.
- 2) Simplified dredging gear, which reduces consumable parts and maintenance costs.
- 3) Power assist grab bucket for dredging hard soil.
- 4) Traveling mooring spud system to eliminate anchor work.
- 5) Operation system that includes remote-controlled life and spud winches.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Nagoya Bay, Aichi Prefecture, Deepening

Location: Nagoya Bay, Japan
Comments: Removal of 5,000,000 m³

Information Sources:

Literature: Title: "Large Scale & Economic Dredging By World's Largest Grab Dredger
"Tosho""
Author: Matsui, Narita, Katase
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 177

Long-Term Maintenance Dredging Contracting Procedures in Belgium

Category: Operating Procedures

Description: The Ministry of Flemish Community (Belgium) dredges approximately 80 to 100 million m³ annually from the River Schelde. Most of the material is placed back into the river in several designated sites. To accomplish this massive dredging operation, the ministry enters into maintenance contracts for 7 to 9 years. The contract requires simultaneous deployment of 5 hopper dredges, 3 sweep beams, 1 oil remover, 1 cutterhead suction, 1 backhoe, and 1 bucket dredger. Payment is provided through bin measurement using an equation developed by the ministry. To track operations, the ministry has developed a dredge information system that provides real-time feedback on key performance parameters such as location, depth of cut, mixture concentration, and several other components of the operation to determine how, where, and what the dredge operator is doing. Weekly surveys are conducted by the ministry to determine assignments for the various dredges working for the ministry at that time. The information system is then employed to determine compliance with the prescribed program. Management and analyses of dredge operations are real-time and are continuously updated by the ministry. The contractor is paid by bin measurement and distance to placement location. Current costs are estimated at \$3.50 to 4.00/m³ (U.S.).

Reviewer: N. McLellan

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

River Schelde

Location: Antwerp, Belgium
Completion Date: Ongoing

Information Sources:

Interviews: Interviewee: Hugo Belmans, Inspector General
Interviewer: Bob Hopman, Neil McLellan
Interview Date: 7/22/98
Interview Location: Antwerp, Belgium

Field Investigations: Location: Antwerp, Belgium
Date: 7/22/98
Photos: Yes
Photo Location: Hartman Consulting Corporation, Bellevue, WA

Low-Turbidity Dredgehead Designs

Category: Environmental Dredging
Pipeline/Discharge Systems

Description: Jan de Nul has developed the low turbidity dredge head (LTDH) . The LTDH has been installed on the cutter suction dredge "Dirk Martens", and is designed to:

1. Remove thin layers of silt with high accuracy.
2. Dredge material at in-situ density.
3. Work in shallow areas.
4. Minimize the mechanical disturbance to reduce turbidity generation and mobilization of contaminants.
5. Extend the automation and monitoring of the dredging process.

The LDTH or sweephead has two inlets and works without additional mechanical movements. A hydraulic valve in the head opens the inlet towards the dredging direction.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

SS Sea Land

Location:	Long Beach, California
Comments:	Approved for BWTF disposal at Alyeska Marine Terminal and Port of Portland

Information Sources:

Literature:

Title:	"Jan de Nul's Environmental Approach"
Month:	8
Year:	1998
LitType:	Periodical
Publisher:	World Dredging and Mining Construction
Page:	8

Method of Measuring and Managing Turbidity on Dredge Projects

Category: Operating Procedures

Description: Rijkswaterstaat is attempting to develop, with the aid of H.R. Wallingford and in cooperation with some of the dredging contractors, a meaningful method of measuring and managing projects based on the turbidity generated during dredging operations. They are interested in some joint efforts with the United States as well as research done in the United States. The goal is to develop a good predictive tool and an indication of what should be measured in the field for verification. Some discussion was provided on what had been done in the United States on turbidity generation at the dredge and some discussion on what could be provided, (IOMT reports on turbidity generation, etc).

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Interviews: Interviewee: Gerard H. van Raalte, Thomas Arts
Interviewer: Bob Hopman, Neil McLellan
Interview Date: 7/23/98
Interview Location: Rotterdam, The Netherlands

Modern Hydraulically Operated Grab Buckets

Category: Dredge Plant

Description: Four Rope Grab Buckets with high closing torque. A maintenance-free design with lifetime lubricated roller bearings for the rope pulleys and guide rollers. Scoop and pressure rod pivot points are equipped with manganese steel bearings. Completely closed covers are used to minimize dust development, and a special scoop geometry optimizes bucket capacity.

Scissor grabs. Short closing stroke with two-strand reeving. The scissor principal increases lip forces during closing.

- Dual-scoop, motor-operated grabs have kick or spill plates that provide a variable bucket volume.
- Single rope grabs - radio-controlled. Bucket is opened with either a ripping cord or by remote control.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Numerous Projects in Europe, Africa

Information Sources:

Literature:

LitType: Periodical
Publisher: Port Technology International
Publication: A4 2/F Fortune Factory Building, 40 Lee Chung Street, Chai Wan Hong Kong
Address:
Publisher Fax: 44 171 404 1670
Page: 135

Monitoring, Control, and Automation of Mechanical Dredges

Category:

Dredge Plant

Production Monitoring

Description:

Recent developments in monitoring, control, and automation of mechanical dredges, including bucket chain ladder dredges, clamshell dredges, and backhoe dredges, including:

- Backhoe position monitor
- Clamshell position monitor
- New controls, using an integrated chair for a bucket ladder dredge.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Year: 1995

LitType: Report/Proceedings

Publisher: WEDA 16

Page: 278

Mo-Slip Ball Joint Liner

Category: Pipeline/Discharge Systems
Description: Elevated discharge pressures in floating pipelines can cause the torque required to deflect the ball joint to exceed that allowable bending strength of the pipe. Friction-reducing ball-joint liner reduces bending stress on the pipe, which in turn reduces the torque required to deflect the ball joint.

Mobile Pulley and Machine Works, Inc. has developed the Mo-Slip ball joint in order to decrease the friction between the ball and gland. The joint is made of urethane type material, a low-friction, low-creep, high-compressive-strength material.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Development of Ball Joint Liners

Comments: 1. Fully developed. Currently on the market.
2. Applicable to all pipeline dredging operations involving floating pipelines.

Information Sources:

Literature: LitType: Report/Proceedings
Year: 1996
Publisher: WEDA 17
Page: 109

New Automation / Instrumentation Systems for Dredges

Category: Dredge Plant
Production Monitoring

Description: New developments in dredging instrumentation include:

Developments in dredge sensor technology:
1) Contactless magnetic angle detector, to determine the position of dragarm on trailing suction hopper dredges.
2) Ceramic capacitive pressure transducer for load and draft measurement.
3) Dredge process pressure measuring special vacuum and pressure transducers to measure draghead depth and the size of the vacuum over the draghead (delta p).
4) High-impact, abrasion-resistant velocity meter liners.

Developments in Stand-Alone and Integrated System:
1) Circuitry improvements for improved reliability.
2) Simulators, for design, testing, and training on dredge instrumentation and operations.
3) Hydrographic and survey systems, as dredge track presentation systems (DTPS) integrated with dredge instrumentation.
4) Integrated control chair.
5) Dredge support computers, which interactively provide production-related answers to "what if" scenarios.
6) Fuzzy control, provides benefit of fine-tuning or "human feeling" in dredge automation design.

Dredging efficiency can be increased 3 to 7 percent by application of the above instrumentation and automation technology. Since the costs represent 5 to 10 percent of the dredge's capital costs, a quick return on the initial investment can be realized.

With the possible exception of the ESSAYONS, the Corps' monitoring and control systems for dredges are approaching 20 years old and require replacement. These developments should be considered when replacement becomes necessary.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"An Update on Dredge Instrumentation and Automation"
Author:	Arie Korevaar
Month:	11
Year:	1994
LitType:	Report/Proceedings
Publisher:	Dredging 94
Publication Address:	ASCE New York, New York
Page:	764

Onsite Confinement of Contaminated Dredged Sediments

Category: Dredged Material Management
Operating Procedures

Description: Lake Ketelmeer is located between two Polders at the mouth of the IJssel River, a portion of the Rhine River system. Over the past 30 years, pollution from industries along the river contaminated sediments that covered 2,800 hectares of the 3,800-hectare lake with approximately 0.5 m of contaminated soils.

To contain the contaminated sediment, the Dutch government designed and constructed a 350-hectare site in the middle of the lake with a capacity of 23 million yards. Onsite confinement was chosen to reduce transportation costs.

The containment facility was built in three phases; 1) removal of the existing contaminants for placement in a temporary holding area, 2) excavation of underlying peat and organic matter to create wetland areas along the fringe of the project, and 3) excavation of glacial sand to a depth of 45 m.

The sand was either sold, stockpiled or used to construct levees around the containment site. Filling the facility is expected to take up to 20 years. The plan is to use extremely accurate dredging methods to remove the sediments from the lake bottom and pump it into the confinement basin. To reduce the chance of seepage of contaminated water into the surrounding aquifer, the bottom portion of the site has been covered with a clay liner, and the site will not be filled above the existing water table. In addition, a pumping system will remove water from the site to ensure that pore pressure within the site remains less than outside the site. The extracted water will be treated. The site will provide environmental enhancement, such as the construction of wetlands and a boater destination. The construction cost of the Ketelmeer project is approximately \$150 million (U.S.).

Reviewer: N. McLellan

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Ketelmeer Lake

Location: Ketelmeerdijk, Holland
Project Cost: \$150 million (U.S.)

Information Sources:

Interviews: Interviewee: W.C.F.H. (Wilbert) van Boldrik
Interviewer: Neil McLellan, Bob Hopman
Interview Date: 7/30/98
Interview Location: Ketelmeerdijk, Holland

Field Investigations: Location: Ketelmeerdijk, Holland
Date: 7/30/98
Photos: Yes
Photo Location: Hartman Consulting Corporation, Bellevue, WA

Overboard Access Retrieval System (OARS)

Category: Safety Procedures

Description: Emergency Overboard Access Retrieval System (OARS). Can be fitted to any passenger vessel to provide a rapid and secure means for evacuating passengers from the vessel to their safety during emergencies. Also provides a safe means of rescuing "man overboard" victims. Full deployment of this system can be accomplished in less than 2 min by one person without the use of tools. Requires only 3 ft² of deck space.

Potential applications on all dredge types, especially hopper dredges. Also can be used as an overside work platform.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Casco Bay Lines "Island Romance" rescue

Location: Maine Coast
Comments: Now standard on Blount shipyard large ferries.

Information Sources:

Literature:
Title: "Platform Patent for Overboard Rescue"
Month: April
Year: 1997
LitType: Periodical
Publisher: World Dredging Mining & Construction
Publication: PO Box 17479 Irvine, California 92623
Address:
Publisher Phone: 714 553-0836
Page: 25

Interviews:
Interviewee: Peter Crockett
Interviewer: Cal Woolley
Interview Date: 9/9/98
Interview Location: Telcon

PC-based Geographic Information System (GIS) for Design and Management of Disposal Sites

Category: Information Systems

Description: Development of user-friendly, PC-based system that incorporates a relational database management system and a Geographic Information System (GIS) for management and design of offshore disposal sites. USACE New York District contracted Science Applications International Corporation (SAIC) and Applied Science Associates (ASA) to develop Disposal Analysis Network for New York District (DAN-NY).

During the spring of 1997, the NYD, WES, and SAIC were involved with the disposal and capping of 700,000 yd³ of mildly contaminated dredged materials at the Mud Dump Site. DAN-NY was used during the design phase to select the optimal disposal location, to test candidate disposal scenarios, and to conduct multiple runs with MDFATE. Dredging, disposal, and capping operations were conducted from May through October 1997. Throughout the project DAN-NY proved to be valuable for:

- 1) Managing the placement of disposal marker buoys.
- 2) Monitoring the locations of individual disposal events.
- 3) Analysis of the near real-time data that were acquired from multiple bathymetric surveys of mound topography.

WES is already in the process expanding elements of DAN-NY to design and manage other offshore disposal sites at other USACE Districts.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Mud Dump Offshore Disposal and Capping

Location: New York
Completion Date: 1997
Project Contact: B. May
Comments: 700,000 yd³ of contaminated dredged material

Information Sources:

Literature: Title: "A User Friendly GIS for Managing Dredged Material Disposal Projects and Environmental Information Within Ports"
Author: McDowell, Inglis, May, Swanson
Month: June
Year: 1998
LitType: Report/Proceedings
Publisher: WODCON XV, Las Vegas
Page: 121

Portable Berm

Category: Pipeline/Discharge Systems

Description: Free-standing containment berm system designed for hazmat applications. Chemical-resistant reinforced liner (synthetic rubber impregnated fabric) protects soil and groundwater from exposure to toxic waste. Used primarily to store hazmat liquids. Has not yet been used to handle sediments. Offered as Port-a-Berm, inflatable dike system; and as Speedi-Berm, folding frame dike system. Maximum size to date 53,000 gal (14 ft x 34 ft) Potential use on small dredging projects involving contaminated sediments, which will require rehandling at some future time.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Numerous Hazmat, petroleum, aircraft refueling, spill containment, etc... applications

Project Cost: \$17,000 (14 ft x 34 ft portable berm)

Information Sources:

Literature: Title: "Aero Tec Laboratories' New Port-a-Berm System"

Month: December

Year: 1994

LitType: Periodical

Publisher: World Dredging Mining & Construction

Publisher Address: PO Box 17479 Irvine, California 92623

Publisher Phone: 714 553-0836

Page: 25

Internet: Internet Address: aerote. @cerf.net

Interviews: Interviewee: David Dack

Interviewer: Cal Wooley

Interview Date: 9/8/98

Interview Location: Telcon

Queen of The Netherlands - State-of-the-Art Jumbo Hopper Dredge

Category: Dredge Plant

Description: The Queen of The Netherlands is a 24,000 m³ trailing suction hopper dredge that was undergoing sea trials when we visited the vessel. Several innovative designs were incorporated into the vessel that could have direct application on vessels in the United States. Some of the innovations are associated with the draghead and how it is designed and outfitted with cutting jets. The newer design has the draghead much wider than dragheads currently used in the United States. The draghead utilizes jets of water to fluidize the sediment before it's captured by the draghead's suction. In addition, the dragheads are designed to dredge at an approximate 30-deg angle to the bottom for better efficiency. These modifications have allowed the dredge to sustain a 30-percent by volume sediment-to-water ratio. In addition, The Queen of The Netherlands employed a recirculating system that takes the decant water from the hopper back to the draghead. This system eliminates conventional overflow and reduces water column turbidity. Also, the dredge pumps employ the high efficiency impellers that can operate at 92 percent efficiency while pumping dredged materials.

Reviewer: B. Hopman

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Interviews: Interviewee: Gerard H. van Raalte, Boskalis
Interviewer: Bob Hopman, Neil McLellan
Interview Date: 7/23/98
Interview Location: Dredge The Queen of The Netherlands

Field Investigations: Location: Dredge The Queen of The Netherlands
Date: 7/23/98
Photos: Yes
Photo Location: Hartman Consulting Corporation, Bellevue, WA

Redesigned Clamshell and Grapple Buckets

Category: Dredge Plant

Description: D& S manufactures a wide range of standard dredge buckets that include innovative features such as:

- Rock buckets with independently operated tines
- Double main shaft designs
- Center line reeving

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

City of Milwaukee Water Intake

Location: Milwaukee, Wisconsin

Completion Date: September 1996

Project Contact: Gary Yaklin

Comments: Durocher Dock & Dredge of Cheboygan, Michigan was contractor.

Ro-Boom - Easily Deployed Silt Curtain

Category: Suspended Sediment Containment

Description: Easily deployed silt curtain. Containment boom made of Neoprene and Hypalone, reinforced with polyester/nylon fabric, with inflatable chambers. Inflated on site using compressed air. Skirt is ballasted with short-link stainless steel chain. Quick coupling sections for extension or replacement of damaged sections without sewing. The design is effective because of its low storage volume, durability, and easy transportation. The system can be supplied fully mounted on a winder or in a containerized winder with accompanying components that the customer assembles as required.

The silt curtain has been used on dredging projects in Denmark and Sweden, including the Oresund Link Reclamation Project.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Oresund Link Reclamation Project.

Location: Copenhagen, Denmark
Completion Date: 2000

Information Sources:

Literature: Title: "Silt Curtains, Design Criteria and Practical Application, Especially for Ro-Boom Silt Curtain"
Author: B.S. Christensen, L., Koch
Year: 1997
LitType: Report/Proceedings
Publisher: CEDA, 1997
Page: 9
Notes: Also IDR, September 1996

Scoop Dredger, Sweep Dredger, Back Hoover

Category:

Operating Procedures
Dredge Plant

Description:

Scoop dredge - First used in 1993. Cutter suction dredge with no rotating parts. Produces little turbidity or interference with debris. Well suited to removing thick layers of silty sediments. Not effective when thin layers must be removed from shallow water.

Sweep dredger - Bilba and Vlaanderen XV. Both capable of dredging a thickness of between 20 and 60 cm (tolerance 5 cm). Can operate in depths as shallow as 1.5 to 2.0 m. Used in Brussels Sea Canal in 1995 and at Brisbane Airport, Australia, and Dutch Port of Nieuwpoort. Sweep dredge is a variation of scoop dredger.

Eco Drag - Mentioned but no detail

Back Hoover - Mini sweep dredger used on Cork Tunnel job. Submersible head with jets mounted on backhoe. In June and August 1997 worked to 25 mm tolerance in silt. Back Hoover produced 500 m³ per day in very thin layer of recently deposited material.

Potential application - Large and small projects involving removal of thin layers of polluted silt with hydraulic dredges.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Seabed Classification

Category: Geotechnical Evaluation Methods
Surveying

Description: QTC VIEW processes information from echosounders to classify seabed based on backscatter analysis from acoustic signals. The QTC VIEW classifies the seabed by first describing the echo and then comparing that description to calibration data from known seabed types. The system consists of a signal processor fed from the customer's echo sounder.

The processor analyzes the signals and compares them to a template. The system accomplishes this by digitizing the first return from the echo sounder, then characterizing its shape and identifying the three most statistically important features of the waveform. The template contains signals for echo sounders working on known bottom conditions, typically provided by the customer. The result is a set of three values representing each echo. Requires calibration using seabed of known classification, then comparing calibration spectrum with that of unclassified seabed. Output from processor is converted to a PC. Output format is in text file format.

The operation involves two phases: calibration and survey operation. During calibration the user would go to a known seabed and collect a set of echoes. This normally requires about 10 minutes at each station. Data are then processed to form a catalog representing each calibration site as a seabed class. In survey mode, the user invokes a catalog, and as the echoes along the track are received the system chooses the class whose calibration data are most similar to the incoming echo and displays it on the computer screen. The system also estimates confidence in that choice. Calibration data are stored as individual data files, allowing the user to develop a library of seabed types that can be used to create catalogues for specific applications.

Common applications for QTC VIEW include fisheries habitat and other environmental studies, dredging and mining. The system has been used on beach renourishment projects to delineate areas of previous dredging on an area of seabed with minimal relief.

QTC VIEW system used by American dredge contractor (Great Lakes Dredge & Dock) for Navy predredge surveys, and by the Dutch in IJmuiden, Holland.

Equipment is commercially available and in use in 17 countries.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Month: September
Year: 1996
LitType: Periodical
Publisher: IDR
Page: 14

Interviews: Interviewee: Karl Rhynus
Interviewer: John Lally
Interview Date: 9/1/98
Interview Location: Telcon

Short Chain Ladders

Category: Dredge Plant

Description: Short chain ladder used on hydraulic pipeline dredges to dredge hard clay and mud, where cutterheads are not effective. Works with hull pump or ladder pump dredges. Used in the mining industry to cut through clay and mud seams. Cutter-bars are attached to an endless chain with a drive sprocket on its upper end and a tumbler located on the lower end. A suction head is located just inboard of the tumbler and removes the material sheared off the bottom by the cutter bars.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Month:	August
Year:	1995
LitType:	Periodical
Publisher:	International Dredging Review
Publication Address:	PO Box 1487, Fort Collins, CO 80522
Publisher Phone:	970 484-9562
Page:	18

Siltmeter

Category: Geotechnical Evaluation Methods

Description: Precision siltmeter based on Aamderaa WRL7 System. Measures suspended solids in rivers, estuaries, and open seas. Uses precision infrared optical sensors. Two AWX sensors measure water temp and conductivity. There is a direct reading mode plus data recording. Data can also be transmitted via an acoustic transducer. Can provide real time, insitu, suspended silt measurements.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:

Title:	"Siltmeter Measures Suspended Solids"
Month:	April
Year:	1995
LitType:	Periodical
Publisher:	World Dredging Mining & Construction
Publisher Address:	PO Box 17479 Irvine, California 92623
Publisher Phone:	714 553-0836
Page:	25

Software Ship Inspection Safety

Category: Safety Procedures

Description: In 1994 Lloyds Register developed software called "Ship Right," which addressed ship safety at the design and construction stages and through a vessel's service life. The new (April 1998) program "Ship Right IS" is an updated and expanded version of "Ship Right"

Uses Microsoft Windows for flexible interface.

Application:

USACE currently uses USCG, ABS, or independent marine surveyors for dredging plant safety issues. "Ship Right IS" would improve current program by putting all safety issues in a single database, thus eliminating costly rule duplication and differences, which would reduce inspection and reporting time. Create dredge database if Lloyds hasn't already done so.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature:	Month:	April
	Year:	1998
	Publisher:	Maritime Reporter
	Page:	10

Spill Monitoring System

Category: Operating Procedures
Safety Procedures

Description: A spill monitoring system has been developed that measures turbidity during dredging, haul and disposal operations, and converts measurements into solids concentrations. The system consists of boats based offshore and land-based units which monitor spill from pump stations at reclamation areas.

The Oresund Link project used 3 boats and 2 land-based plants, with a staff of 12-42 people.
Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Oresund Link Project

Information Sources:

Literature: Title: "Spill Monitoring at the Oresund Link Project"
Author: Klaus Hogtt
Year: 1997
LitType: Report/Proceedings
Publisher: CEDA 1997
Page: 9

Stabeach**Category:****Description:****Shoreline Stabilization**

Beach stabilization method that enhances natural accretion of sand. The method consists of installing a drainage system under the beach. The drains are connected by underground piping to a pumping well landward of the beach, generally behind the dune. Pumps in the well remove groundwater from under the beach and discharge it into the ocean or bay. The beach within the influence of the drainage system has a continuously lowered water table. When the water table under the beach is lower than the water level of the ocean, accretion of sand particles on the beach slope is observed. Water from incoming waves drains more easily through the dry beach, leaving a portion of its suspended sands on the beach. As water percolates through the beach, sands compact, making it more resistant to erosion.

The Stabeach System provides an alternative method of shoreline stabilization to beach restoration / nourishment.

Reviewer: J. Lally

Company / Organization(s):**Access Restricted to U.S. Army Corps of Engineers*****Projects Completed:*****Sailfish Point**

Location: Stuart, Florida
Completion Date: 5/89

State-of-the-Art Multibeam Sounding Equipment

Category: Surveying

Description: The SeaBat 9000 series are small, lightweight, and highly accurate multibeam echo sounders that can be installed over the side or through the hull of a small vessel, dredge, ROV, or ocean going vessel. The transducers can be mounted at various angles, providing the ability to look out to the side, either under moored vessels or areas that would obstruct a surface vessel. The current range of SeaBats offer swath angles of 90 to 180 deg.

Other Features:

1. Complies to IHO accuracy.
2. Narrow beams.
3. Lightweight and portable.
4. Vessel and ROV mountable.
5. Multibeam imagery upgradeable.
6. Uses high accuracy bottom detection method.
7. Real-time quality control.

Using sonar, each beam looks at the seafloor and provides information on what it sees. With the SeaBat Systems being able to update all the beams simultaneously, up to 30 times per second, any object moving through the beams can be seen and recorded. The SeaBat can be installed on a moving platform (boat, submarine, underwater vehicle) and any movement will not interfere with the SeaBat's performance.

The Seabat can be used to obtain more accurate and faster bathymetric data for dredge surveys, and can also be mounted on the dredge itself to indicate "real-time" dredge survey information to the operator prior to moving ahead.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Oresund Link

Location: Copenhagen, Denmark
Completion Date: 2000

Information Sources:

Literature: Title: "Multibeam in Dredging & Future Trends"
Author: P Resen, Steenstrup
Year: 1997
LitType: Report/Proceedings
Publisher: CEDA
Page: 25

Internet: Internet Address: www.reson.com
Internet Search Date: 9/20/98

Stockton Bucket

Category:

Dredge Plant

Description:

The Stockton Bucket was an evolution of bucket designs for digging large amounts of mud, originally developed to build levees as part of land reclamation efforts in the Sacramento Delta at the end of the 19th century. Bucket has evolved and is still in use today. Unique round design allows material to stack up better without voids, optimizing bucket capacity. The bucket closes like ice tongs by lifting on the arms. Longer arms allow the bucket to dig harder material. Opening is by cables attached to the edges of the shells. A light bucket with high cutting force (8 -yd³) bucket will move about 1500 yd³ per 10-hr shift. Buckets are mild steel with hardened lips. One design has teeth.

Stockton bucket application is best for mud/sand dredging, and levee maintenance . While efficiency is not impressive (1500 yd³/600 min = 2.5 yd³/min; 2.5 yd/min /8 yd bucket = .31) It is probably higher than other bucket types working in the same material.

Stockton Bucket is fully developed. Its principal application is for building levees from dredged materials.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Numerous dredging and reclamation projects completed in San Joquin and Sacramento Delta areas.

Information Sources:

Literature:

Title: "Tule Breakers"
LitType: Book
Publisher: Stockton Corral of Westerners International, University of Pacific
Publication Address: Stockton, CA 95211
Notes: Book is on the history of development of the Sacramento/San Joaquin Delta Reclamation

Month: February
Year: 1998
LitType: Periodical
Publisher: International Dredging Review
Page: 6
Notes: Photo on cover

Sub-Bottom Profiling to Delineate Areas of Contaminated Sediments

Category: Geotechnical Evaluation Methods

Description: Pelagos Corporation has developed a process to improve the efficiency of bottom sampling. Seismic sub-bottom profiling is performed to determine locations of core samples. This reduces the number of samples required. The system can also be used to determine dredgeability.

Port of Oakland Inner and Outer Harbors were surveyed using DGPS for NOV POS, A Raytheon DE 719 Echo Sounder for bathymetry and a sub-bottom profiling system consisting of:

1. Energy source/receiver O.R.E. (1-12 kHz).
2. Analog recorder - EPC 3200 s.
3. Digital recorder/processor - ELICS Delphi.

System proved to be very effective in delineating a wide range of disturbed sediment deposits, which were shown by core sampling and testing to contain various amounts of contamination.

When combined with normal sediment sampling and testing using compatible navigation accuracy, this technique provides a more accurate delineation of contaminated areas.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Oakland Outer and Inner Harbors

Location: Oakland, California
Completion Date: August & September 1993

Panama, Great Lakes Dredge & Dock

San Diego Bay, U.S. Navy

Information Sources:

Literature: Month: May
Year: 1994
LitType: Report/Proceedings
Publisher: WEDA XV
Page: 33

Submerged Dikes to Control Sedimentation

Category: Coastal/Hydraulic Systems
Dredged Material Disposal
Operating Procedures

Description: Submerged dikes constructed of sand-filled geofabric containers used to manipulate river flow and control sedimentation.

The U.S. Army Corps of Engineers, New Orleans District designed and constructed the Red Eye Crossing Soft Dikes Demonstration Project for \$7.1 million in 1994. The Red Eye Crossing is about 2 miles long, with the channel crossing from the east bank to the west bank. Crossings create water conditions conducive to shoaling. The Red Eye is particularly troublesome because the channel is relatively wide at that point, about 3,700 ft. This forces the Corps of Engineers to bring in dredges to maintain the 45-ft channel to Baton Rouge. Each year, the Corps brings in two dustpan dredges, the government dredge Jadwin and a private dredge, to remove sediment deposited in the high-water season. Sometimes, hopper dredges must be called in as reinforcements. The intent of the Red Eye soft dikes is to provide passive dredging whereby the Mississippi can dredge itself. Fewer cubic yards must be dredged, saving the government millions of dollars and avoiding the consumption of thousands of gallons of diesel fuel.

Six submerged dikes were constructed using geofabric containers, both larger geocontainers (200-300 yd³) and smaller geobags (3 yd³), filled with coarse river sand from a nearby shoal. The containers were filled and sewed shut in a split hull barge. Once the bag was closed, the bottom of the barge opened to drop it into place in a dike at the crossing. The contractor was Luhr Bros., Inc., based in Columbia, Illinois.

The six soft dikes are perpendicular to the river flow, extending along the east bank for just under 1½ miles. The dikes are progressively longer going downstream, from 680 ft to 1,750 ft. The intent of the dikes was to constrict the Mississippi's flow, concentrating it in a narrower channel to increase flow velocities and decrease sedimentation. This constricted Red Eye River to about 2,000 ft, the same as the width of the non-dredging crossings the Corps was trying to mimic. The Red Eye dikes are similar to hundreds of rock dikes that have been used successfully for many years on the river above Baton Rouge. As they are soft, they are safer and unobtrusive. The soft dikes lie lower than the nearby sandbar that was used to fill the bags.

Navigation safety has been a prime concern with the soft dikes. The first 4 years have seen no reported incidents attributable to the project.

The Red Eye project will have paid for itself by the end of 1998. The Corps is preparing to move on to other river crossings below Baton Rouge, with the Medora Crossing next, located 12 miles downriver from Red Eye. The Medora dikes, whose construction is planned for fiscal year 1999, will have three dikes, as opposed to the six at Red Eye.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

(Continued)

Submerged Dikes to Control Sedimentation (Concluded)

Projects Completed:

Red Eye Crossing Soft Dikes Demonstration Project

Location: Baton Rouge, Louisiana
Completion Date: 1994
Project Contact: Keith O'Cain, Fred Schilling
Project Cost: \$7,100,000
Overall Cost Savings: \$6,000,000 over first 4 years. \$1,500,000/year
Estimated Cost: \$7,100,000
Comments: Project will have paid for itself in 1998.

Information Sources:

Literature: Title: "Corps Experiment is Saving \$\$ Millions"
Author: USACE, New Orleans District
Year: 1995
LitType: Report/Proceedings
Publisher: News Release
Publication Address: P.O. Box 60267, NO LA
Publisher Phone: (504) 862 2545
Page: 4
Notes: WEDA 16 Proceedings, pg 286

Internet: Internet Address: www.mvn.usace.army.mil
Internet Search Date: 9/14/98

Submersible, Transportable Utility Marine Pump (STUMP)

Category: Dredge Plant
Description: Application of Submersible, Transportable Utility Marine Pump (STUMP)

Advantages include:

- Not affected by sea conditions
- Low turbidity
- Low maintenance
- Reduced navigation hazard
- Safety

STUMP dredge is privately owned and is available in 15-cm at 40-hp and 20-cm dredge pump with 10-cm jet pump combination with 177-hp Cummins Turbo diesel engine.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Caloosahatchee River

Location: Iona, Florida
Comments: 0.8-km channel dredging

Fishermans Village, Punta Gorda, Florida

Location: Punta Gorda, Florida
Project Contact: Fisherman's Village

Keewaydin Island

Location: Naples, Florida
Comments: Dredged 0.5-km channel from Gordon River to a marina.

Port Charlotte, Florida Navigation Channel

Location: Port Charlotte, Florida
Comments: 30-ft entrance channel dredging

Removal of coal dust from a settling pond

Location: Joliet , IL
Project Contact: Commonwealth Edison
Comments: Removal of 5,800 m³ of coal dust from a settling pond

Information Sources:

Literature: Title: "The STUMP - A New Dimension in Dredging"
Author: George Batchelder
Month: 11
Year: 1994
LitType: Report/Proceedings
Publisher: Dredging 94
Publication: ASCE, New York, New York
Address:
Page: 701

The Silent Inspector System

Category: Claims Resolution
Operating Procedures
Production Monitoring

Description: The Silent Inspector (SI) is a data-acquisition, communication, analysis, and reporting system developed by the USACE to assist in the inspection of contract dredging operations. The SI has successfully served as an inspection and management tool for numerous USACE contract dredging projects. Project management, environmental surveillance, claims reduction, and standardized contractor requirements are all addressed by the SI. The SI is fully developed for hopper dredging operations, with a system for hydraulic pipeline dredges under development. The SI system can successfully be applied to more Corps dredging projects.

To ensure that the SI is widely adopted within the Corps and its contract dredging industry partners, a Process Action Team with both Corps and industry participation has been formed. This team will recommend standards (data acquisition, data transfer, and quality assurance) that comprise the functional aspects of the SI for approval by Corps policymakers.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Location: Numerous Corps dredging projects on all coasts

Information Sources:

Literature:

Title:	"The Silent Inspector System"
Author:	James Rosati III
Month:	7
Year:	1998
LitType:	Report/Proceedings
Publisher:	WODCON XV, Las Vegas
Page:	93

Treatment of Copper-Contaminated Marine Sediments

Category: Environmental Dredging
Operating Procedures

Description: Recent developments in physical and chemical system handling of contaminated sediments, performed on the 1993/94 Port of San Diego Cleanup Project

The principal contaminant was copper. Twenty-one-thousand cubic yards of copper contaminated sediments were dredged using a 4-yd³ enclosed clamshell bucket within a silt curtain. Sediments were tested as they were being dredged. Sediments having concentrations over 2,500 PPM were treated by a physical separation system. Sediments containing less than 2,500 PPM were treated by chemical fixation. Physical separation treatment using hydrocyclones processed approximately 9 tons/hr. Approximately 1,100 tons of copper-containing sediment were recycled to a mining facility in Arizona. Chemical fixation treated up to 100 tons/hr. At a compaction rate of up to 95%, 17,800-yd³ of chemically fixated sediments were placed in the onsite repository. Some 356 tons of ferrous material and 713 tons of non-ferrous material were screened and separated from the dredged sediments. All of this material was either sent to a scrap metal recycler, landfill, or private metal handler.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Port of San Diego Copper Cleanup Project

Location:	San Diego, California
Completion Date:	1994
Project Contact:	Eileen Maher
Project Cost:	\$8.5 million

Information Sources:

Literature:	Month: 5
	Year: 1995
	LitType: Report/Proceedings
	Publisher: WEDA 16
	Page: 213

Use of Physical Models to Develop Shellfish Excluder Device

Category: Development of Dredge Components and Equipment
Environmental Dredging

Description: Model testing provided the following advantages over full-scale testing.

- 1) Tests were designed by a team consisting of a) a fisheries biologist, b) an engineer specializing in physical model design and operation, c) an engineer with dredging experience.
- 2) Fifty configurations were tested before the prototype configuration was selected. The cost of this process was insignificant compared to doing it on a working dredge.
- 3) Model was operated with live crabs to evaluate their interaction with the draghead, with and without the excluder installed.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Excluder model tests

Location:	Scripps NYD Lab
Completion Date:	1995 prototype at Grays Harbor 1997. Prototype at MCR in progress (1998)
Project Contact:	Portland/Seattle Districts USACE
Project Cost:	~ \$60,000 for model testing
Estimated Cost:	\$15,000 to fab and install
Comments:	Seattle District current crab mitigation costs at Gray's Harbor up to \$500,000/year. Estimate that use of Excluder will cut that cost by one half.

Information Sources:

Literature:

Title:	"The Use of Physical Models to Develop a Device to Prevent Entrainment of Dungeness Crab During Hopper Dredging Operations"
Author:	KW Larson, C. Woolley, J. Powell
Month:	May
Year:	1994
LitType:	Report/Proceedings
Publisher:	WEDA XV
Page:	210

Use of Small Auger Dredge to Reduce Turbidity

Category: Operating Procedures

Description: Horizontal auger-type dredges are effective in dredging contaminated sediments with minimum resuspension. Uses Mudcat positive displacement pump (PDP) dredge at Sydney, Nova Scotia.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Sydney, Nova Scotia

Location: Sydney, Nova Scotia.

Information Sources:

Literature: Title: "Turbidity Generated by Small Dredges"
Month: May
Year: 1994
LitType: Report/Proceedings
Publisher: WEDA XV
Page: 133
Notes: Paper reprinted from "Environmental Protection," June 1994 pp. 56-59

Vacuum Clamshell Bucket

Category: Dredge Plant

Description: Conversion of standard clamshell bucket to vacuum clam used for remediation dredging operation at Welland River, Ontario, Canada.

Conversion consisted of adding a vacuum chamber to the outside of the bucket. This arrangement allowed for successful removal of heavy liquid (coal tar) from the bottom, along with the adjacent contaminated sediment.

Vacuum clam was constructed by Dufresne Construction of Montreal PQ. - Design by Sanex International, also of Montreal PQ.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Information Sources:

Literature: Publisher: Dredging 94
Page: 991

Viscous Excavator (Rotary Dredge Cutterhead)

Category: Dredge Plant

Description: Cutterhead designed to work in viscous materials. Attaches to standard cutter suction dredge ladder. Open three-bladed screw with cupped blades moves high-viscosity materials such as coal tar, paper sludge, organic waste, and/or petroleum sludge. Can also dredge sand and clay. Will dredge up to 50-60-percent solids. Can be installed on existing cutterhead suction dredges with suction sizes 6 in. and larger.

Turnaround time for ordering is 4 to 8 weeks, depending on size.

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:**CF Industries**

Location: Fort Green Springs, Florida
Comments: Purchased two dredges to dredge sand from an adjacent deposit and mixed it with dredged clay to form a load-bearing land base.

Northern Glory Dredging

Location: Elkford, BC, Canada
Completion Date: 1997
Comments: Recovering coal fines for Fording Coal Company

Water Injection Dredging (WID)

Category: Dredge Plant

Description: Water injection dredging (WID) has been used in Europe and Asia since the 1980's, and the United States since 1992. WID dredge is owned and operated in the U.S. by Gulf Coast Trailing, a subsidiary of T.L. James Marine Group, and partner with the Dutch firm HAM. HAM has the worldwide patent on WID technology. WID has been primarily used along the Mississippi River for removal of shoaled material around docks where the dredged material can be fluidized and redirected into the river flow for deposition in deeper sections of the adjacent channel. Other advantages of WID include:

- 1) An area that contains debris can be dredged successfully without effecting production.
- 2) Dredging can be conducted under docks and congested locations .

Reviewer: C. Woolley

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Numerous maintenance dock dredging projects along Mississippi River and Houston Ship Canal

Location: Gulf Coast

Comments: TL James Marine Group is currently in process of dismantling subsidiary dredging companies (Gulf Coast Trailing, TL James). Future ownership of WID technology is not known at this time.

Information Sources:

Literature:

Title:	"Water Injection Dredging in the USA"
Author:	David Knox
Month:	6
Year:	1996
LitType:	Report/Proceedings
Publisher:	WEDA 17
Page:	1

WINOPS Real-Time Dredge Positioning Software

Category: Navigation/Positioning Systems

Surveying

Description: "WINOPS" is a data acquisition and conditioning system used to correlate a dredge's position with the position of a bucket, cutterhead, or draghead. It can accept signals from GPS, and various pressure, electro-mechanical, or acoustic transducers and hydrographic instrumentation and provide the dredge operator with real-time dredge position relative to the bucket cutterhead or draghead locations, all relative to the channel. The system provides channel cross sections and positions in x, y, and z planes. It can also factor in tidal data when appropriate. The system uses PC's with Windows 95/NT operating systems.

Reviewer: J. Lally

Company / Organization(s):

Access Restricted to U.S. Army Corps of Engineers

Projects Completed:

Pascagoula, MS Submarine Turning Basin

Location: Pascagoula, MS

Estimated Cost: \$12,000

Comments: Installed on Manson Dredges "Njord," "Viking," "Newport," and "Westport," and Dutra Dredges "550," "551," "Super Scoop," and "Paula Lee."

Information Sources:

Literature: Title: "GPS-Based Software Providing Real-Time Position to Dredges, Buckets, Cutters, and Dragheads"

Month: 7

Year: 1998

LitType: Periodical

Publisher: International Dredging Review

Page: 16

Interviews:

Interviewee: Lyman Burk

Interviewer: John Lally

Interview Date: 6/30/98

Interview Location: WODCON, Las Vegas

References

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- Detzner, H. D., Schramm, W., Doring, U., and Bode, W. (1998). "New Technology of Mechanical Treatment of Dredged Material from Hamburg Harbour," *Water Science Technology* 37(6-7), 337-343.
- Unwelttechnik, ETH. (1998). "Responsible Acting for the Future," Hamburg, Germany.

Appendix A

Listing of Technologies by Category

Beneficial Use of Contaminated Sediments

LADS - Lightweight Aggregate from Dredged Sediment

Capping Polluted Sediment

Feasibility of Capping Industrial Waste Disposal Sites with Dredged Material

Claims Resolution

The Silent Inspector System

Coastal/Hydraulic Systems

Submerged Dikes to Control Sedimentation

Computerized Dredging System

Computerized Dredging

Contaminated Material Disposal

Sand Separation for Contaminated Sediment Disposal - Port of Rotterdam

Contaminated Sediment Handling

Cleanup Dredges - Thin Layer Removal of Contaminated Sediments

Contracting Procedures

Economic Decision Framework for Estimated Benefits and Costs of Sediment Remediation

Estimating Contaminant Losses During Dredging

Development of Dredge Components and Equipment

Use of Physical Models to Develop Shellfish Excluder Device

Dredged Material Disposal

Cement and Soft Mud Mixing Technique Using Compressed Air-Mixture Pipeline

GLOBALtechs : SEDTEC / REMTEC

Submerged Dikes to Control Sedimentation

Dredged Material Management

Onsite Confinement of Contaminated Dredged Sediments

Dredge Plant

Aquatic Vegetation Removal
Automated Sludge Removal With High-Density Dredger
Cleanup Dredges - Thin Layer Removal of Contaminated Sediments
Coral / Rock / Concrete Excavator
Deep Dredging
Development of an Active Mass Damper for Stabilizing Loads Suspended on a Floating Crane
Dredge System Improvements
Dredge System Innovations
Heavy Duty Bucket to Dredge Rock
Hopper Dredge Recirculation System
Innovations in Dredging Equipment
Innovative Design of a Multiport Diffuser
Innovative Dredge Systems - Degroot Nijkerk, Damen Shipyards
Instrumentation for Clamshell Buckets
Large-Scale and Economic Dredging by World's Largest Grab Dredger
Modern Hydraulically Operated Grab Buckets
Monitoring, Control, and Automation of Mechanical Dredges
New Automation / Instrumentation Systems for Dredges
Overflow Water Recirculation System
PUNAISE
QUEEN OF THE NETHERLANDS - State-of-the-Art Jumbo Hopper Dredge
Redesigned Clamshell and Grapple Buckets
Scoop Dredger, Sweep Dredger, Back Hoover
Short Chain Ladders
Stockton Bucket
Submersible, Transportable Utility Marine Pump (STUMP)
Underwater Bottom Crawling Dredge
Vacuum Clamshell Bucket
Viscous Excavator (Rotary Dredge Cutterhead)
Water Injection Dredging (WID)

Environmental Dredging

Cement and Soft Mud Mixing Technique Using Compressed Air-Mixture Pipeline
Environmental and Geographic Information System for Dredge Control
GLOBALtechs : SEDTEC / REMTEC
Low-Turbidity Dredgehead Designs
Treatment of Copper-Contaminated Marine Sediments
Use of Physical Models to Develop Shellfish Excluder Device

Environmental Monitoring

GLOBALtechs : SEDTEC / REMTEC

Equipment Maintenance

Computerized Maintenance Management System
Greasemaster
Improve Hardfacing Procedures

Geotechnical Evaluation Methods

- Custom Turnkey Hydrographic Package
- Dredge System Improvements
- Seabed Classification
- SedErode +
- Siltmeter
- Sub-Bottom Profiling to Delineate Areas of Contaminated Sediments

Information Systems

- PC-based Geographic Information System (GIS) for Design and Management of Disposal Sites

Material Separation

- Separation of Fine-Grained Contaminated Sediments, The Netherlands

Measurement & Payment Methods

- Custom Turnkey Hydrographic Package

Navigation/Positioning Systems

- ATB (Articulated Tug/Barge Unit)
- Custom Turnkey Hydrographic Package
- WINOPS Real-Time Dredge Positioning Software

Operating Procedures

- Acoustic Measurements of Suspended Soils
- Contaminated Sediments Dredged Material Management - Germany
- Deep Dredging
- Delivering Dredge Slurry Through Long Pipelines
- Dredge Plant Management Program - Port of Rotterdam, The Netherlands
- Dredging in Unexploded Ordnance (UXO) Contaminated Sediment Greasemaster
- Improved Bioassay Testing Procedures
- Improved Methods for Correlating Turbidity and Suspended Solids
- In-Water Disposal of Dredged Sediments
- Innovative Capping Procedures - Puget Sound Region
- Innovative Dredging Practices - Rijkswaterstaat, Holland
- Instrumentation for Hazmat Dredging Projects
- Long-Term Maintenance Dredging Contracting Procedures in Belgium
- Method of Measuring and Managing Turbidity on Dredge Projects
- Onsite Confinement of Contaminated Dredged Sediments
- Port Contracting Procedures in UK
- Scoop Dredger, Sweep Dredger, Back Hoover
- The Silent Inspector System
- Spill Monitoring System
- Submerged Dikes to Control Sedimentation
- Treatment of Copper-Contaminated Marine Sediments
- Use of Small Auger Dredge to Reduce Turbidity

Pipeline/Discharge Systems

- Application of Hydrocyclones for Maintenance Dredging Operations
- Cement and Soft Mud Mixing Technique Using Compressed Air-Mixture Pipeline

Innovations in Dredging Equipment
Delivering Dredge Slurry Through Long Pipelines
Low-Turbidity Dredgehead Designs
Mo-Slip Ball Joint Liner
Overflow Water Recirculation System
Portable Berm

Production Monitoring

Automated Disposal Surveillance System (ADDIS)
Custom Turnkey Hydrographic Package
Dredge Performance Indicators for Monitoring Cutterhead
Dredging Operations
Dredge Production Monitoring
Dredge System Innovations
Dredging and Backfill Operations in a Hostile Environment
Environmental and Geographic Information System for Dredge
Control
Interface Detector
Innovative Dredge Systems - Degroot Nijkerk, Damen Shipyards
Monitoring, Control, and Automation of Mechanical Dredges
New Automation / Instrumentation Systems for Dredges
The Silent Inspector System

Pumps

Delivering Dredge Slurry Through Long Pipelines
Developments in Submerged Dredge Pumps and their Drives
Dredge System Improvements
Dredge System Innovations
Eddy Pump
Innovations in Dredging Equipment
Innovative Dredge Systems - Degroot Nijkerk, Damen Shipyards
Overflow Water Recirculation System
PUNAISE

Safety Procedures

Development of an Active Mass Damper for Stabilizing Loads
Suspended on a Floating Crane
Dredging in Unexploded Ordnance (UXO) Contaminated Sediment
Overboard Access Retrieval System (OARS)
Spill Monitoring System
Software Ship Inspection Safety

Sediment handling

Centrifuge Dewatering

Shoreline Stabilization

Stabebach

Surveying

Beach Nourishment Measurement and Payment
Custom Turnkey Hydrographic Package
Seabed Classification
State-of-the-Art Multibeam Sounding Equipment
WINOPS Real-Time Dredge Positioning Software

Suspended Sediment Containment

Ro-Boom - Easily Deployed Silt Curtain

Appendix B

Listing of Technologies by Country

Belgium

Cleanup Dredges - Thin Layer Removal of Contaminated Sediments
Long-term Maintenance Dredging Contracting Procedures in
Belgium
Low Turbidity Dredgehead Designs
Scoop Dredger, Sweep Dredger, Back Hoover

Canada

GLOBALtechs: SEDTEC / REMTEC
Seabed Classification
Vacuum Clamshell Bucket

Denmark

Deep Dredging
Environmental and Geographic Information System for Dredge
Control
Ro-Boom - Easily Deployed Silt Curtain
Spill Monitoring System
State-of-the-Art Multibeam Sounding Equipment

Germany

Contaminated Sediments Dredged Material Management - Germany
Dredge Systems Innovations
Hopper Dredge Recirculation System
Modern Hydraulically Operated Grab Buckets

Japan

Automated Sludge Removal With High-Density Dredger
Cement and Soft Mud Mixing Technique Using Compressed Air-
Mixture Pipeline
Development of an Active Mass Damper for Stabilizing the Load
Suspended on a Floating Crane
Large-Scale and Economic Dredging by World's Largest Grab
Dredger

The Netherlands

- Cleanup Dredge Thin Layer Removal on Contaminated Sediments
- Developments in Submerged Dredge Pumps and their Drives
- Dredge Plant Management Program - Port of Rotterdam, The Netherlands
- Dredge Production Monitoring
- Dredge System Improvements
- Innovations in Dredging Equipment
- Innovative Dredging Practices - Rijkswaterstaat, Holland
- Method of Measuring and Managing Turbidity on Dredge Projects
- Monitoring, Control, and Automation of Mechanical Dredges
- New Automation / Instrumentation Systems for Dredges
- Onsite Confinement of Contaminated Dredged Sediments
- Overflow Water Recirculation System
- PUNAISE
- QUEEN OF THE NETHERLANDS - State-of-the-Art Jumbo Hopper Dredge Sand Separation for Contaminated Sediment Disposal - Port of Rotterdam
- Separation of Fine-Grained Contaminated Sediments, The Netherlands

United Kingdom

- Acoustic Measurements of Suspended Soils
- Coral / Rock / Concrete Excavator
- Custom Turnkey Hydrographic Package
- In-Water Disposal of Dredged Sediments
- Port Contracting Procedures in UK
- SedErode +

United States

- Automated Disposal Surveillance System (ADDIS)
- Application of Hydrocyclones for Maintenance Dredging Operations
- Aquatic Vegetation Removal
- ATB (Articulated Tug/Barge Unit)
- Automated Disposal Surveillance System (ADDIS)
- Beach Nourishment Measurement and Payment
- Centrifuge Dewatering
- Computerized Dredging
- Computerized Maintenance Management System
- Delivering Dredge Slurry Through Long Pipelines
- Developments in Submerged Dredge Pumps and their Drives
- Dredge Performance Indicators for Monitoring Cutterhead Dredging Operations
- Dredging in Unexploded Ordnance (UXO) Contaminated Sediment
- Economic Decision Framework for Estimated Benefits and Costs of Sediment Remediation
- Eddy Pump
- Estimating Contaminant Losses During Dredging
- Feasibility of Capping Industrial Waste Disposal Sites with Dredged Material
- Heavy Duty Bucket to Dredge Rock
- Improve Hardfacing Procedures

Improved Bioassay Testing Procedures
Improved Methods for Correlating Turbidity and Suspended Solids
Innovations in Dredge Equipment
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The report provides detailed descriptions of 11 of the 176 technologies identified as having promise. By investigating and documenting these solutions and reviewing them relative to the Corps dredging program, there is potential to identify and implement those procedures showing high promise to reduce the cost of conducting dredging operations performed or managed by the Corps.

14. (Concluded).

Dredging
Dredging management
Dredging operations
Environmental dredging
Innovative technology
Sediment handling